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Practical Drawing.

BY J. G. A. MEYER.

FORTY-THIRD PAPER.

398. *Remarks.* Should the student find it too difficult to make a drawing similar to that represented by Figs. 281 and 282 of a bearing, he may lay it aside until further advancement has been made. But by a determination on the part of the student to overcome all difficulties in making this drawing, and a perseverance until it is finished, before any other problem is taken up, he will derive a greater benefit than by laying it aside. Any doubt that the student may have as to the manner of obtaining the relative positions, in the two views, of points and lines which represent one and the same thing, indicates that the previous problems have not been thoroughly understood, and therefore, under such circumstances, the student should again read and study all the previous problems which bear on this subject, so as to enable him to make this drawing correctly; pains should also be taken to make it neatly.

Problem 56.

SIDE ELEVATIONS.

399. In order to explain clearly the methods employed for obtaining the projections of some of the objects which are to follow, it will be desirable to show three distinct views or projections of each solid; that is to say, instead of showing a vertical projection (front elevation) and a horizontal projection (plan) we shall sometimes add a side elevation (sometimes called an end view) of the same solid.

It is therefore necessary to explain the principles upon which the constructions of the side elevations are based, and also the principles by which the relative position of the side elevation to the positions of the other two views may be determined.

400. Let *A B E F*, Fig. 284, represent the horizontal plane of projection, and let the heavy line *A B* be the edge of the vertical plane of projections represented as standing perpendicular to the horizontal plane *A B E F*. In Art. 217 we see that a separate plane of projection is required for each view or projection of a solid, and therefore, to obtain a side elevation we must now add another plane of projection to the two already named. Let the heavy line *B F* represent the edge of such a plane of projection standing perpendicular to the horizontal plane *A B E F*, and also at right angles to *A B*. Here then we have three planes of projections, one of them being a horizontal plane, and the other two are vertical planes. The plane represented by the line *A B* we shall call—as before—the vertical plane of projection; and the plane represented by the line *B F* we shall name the second vertical plane of projection.

The reason for placing the planes of projection at right angles to, or square with each other, lies in the fact that, generally, the parts which compose a machine are either arranged parallel to each other, or disposed at right angles, and therefore by arranging the planes of projection in a manner as here shown, we can place these planes so as to coincide with the disposition of nearly all the different parts of a machine, and thereby obtaining projections in which forms shown foreshortened will be avoided as much as possible, and the true dimensions of the machine will be shown; in short, by placing the planes of projections at right angles to each other, we will be enabled to conceive most readily how objects are situated in space when their projections are known. See Art. 258.

Let $i_2\ k_2\ n_2$ (Fig. 284) represent the upper base of a prism which is to be projected. The manner of projecting this prism on the vertical and horizontal plane of projections is clearly shown in Fig. 164, and the principles upon which the method of projecting this prism is based are the same as those by which the projections of points, lines and planes are determined, as explained in Articles 210 and up to 259, and therefore nothing further in regard to the horizontal and vertical projections in Fig. 284 need to be said.

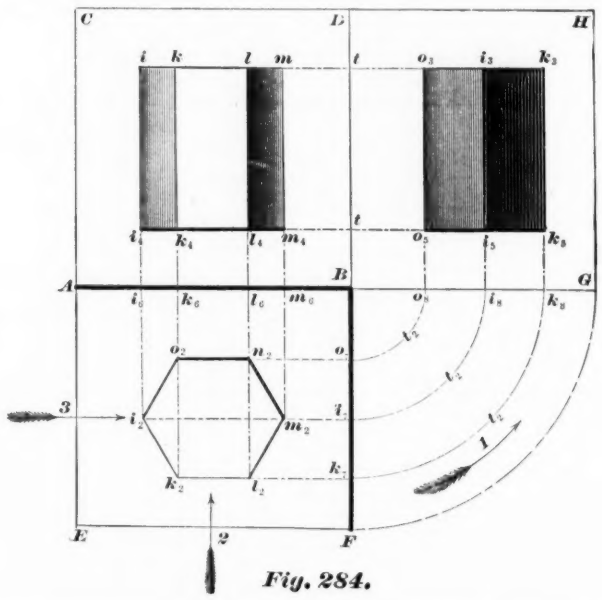


Fig. 284.

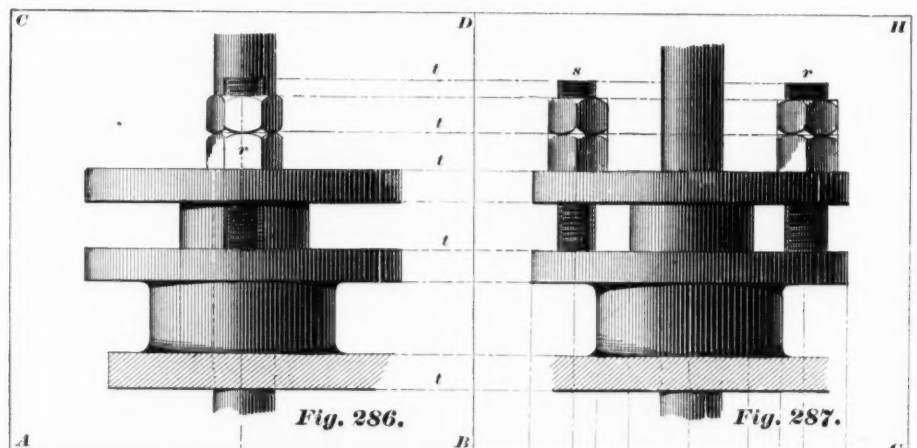


Fig. 286. *Fig. 287.*

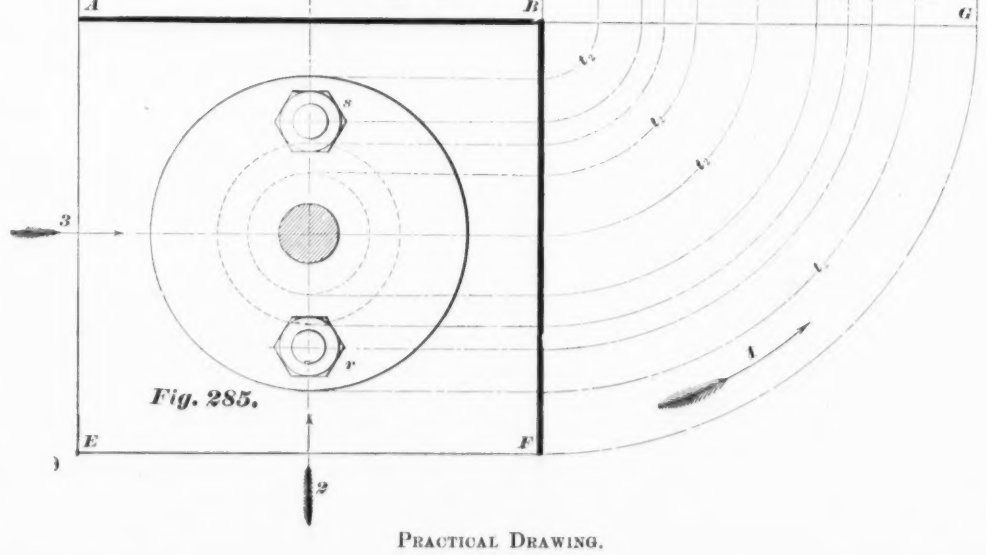


Fig. 285.

Now, in order to obtain a side view of this prism, we project it on the second vertical plane of projection *B F*, in a manner precisely similar to that adopted in projecting it on vertical plane of projection *A B*; namely, we assume that, through the points $o_2\ i_2\ k_2$—which are the extremities of the edges of the prism—lines are drawn perpendicular to the plane of projection *B F*, and the points $o_7\ i_7\ k_7$, in which these lines cut the plane *B F*, will be on this plane, the projections of the points or extremities $o_2\ i_2\ k_2$; then, by joining the projections $o_7\ i_7\ k_7$ by straight lines (Art. 246), and also joining by straight lines the projections of all the extremities of the edges which can be seen, the projection of the prism on the plane *B F* will be completed.

Now, in order to make the second vertical plane of projection to coincide with the plane of the paper, so that we can see the projection upon it, we revolve it around the line in which the two vertical planes of projection intersect each other. In revolving the plane *B E* around this line as an axis, the projections of the extremities of the edges of the prism will move in the arcs of $o_7\ o_8$, $i_7\ i_8$, etc., of a circle; and when the plane *B F* has been made to occupy the position represented by the line *B G*, which is an extension of the line *A B*, we revolve the plane around the line *B G* until it coincides with the plane of the paper; in doing so, points $o_8\ i_8\ k_8$ will move in paths represented by the straight lines $o_8\ o_3$, $i_8\ i_3$ and $k_8\ k_3$. Therefore, when the second vertical plane of projection coincides with the plane of the paper, its outline will be represented by the rectangle *B G D H*, and the side view, or the projection of the prism upon this plane of projection will be represented by the lines $o^3\ i_3\ k^3\ o^5\ i_5\ k_5$; and this side view shows the appearance of the prism when looked at in a direction indicated by the arrow marked 3; whereas, the projection $i\ m\ i_4\ m_4$ shows the appearance of the prism when looked at in the direction indicated by arrow 2.

401. But now notice, during the time that projections of the prism are made on the two vertical planes of projections, the distances between the bases of the prism and the horizontal plane of projection are not changed, and since the lines $i_4\ m_4$ and $o_5\ k_5$ are the vertical projections of the lower base, it follows that the distance between the line $i_4\ m_4$, and the ground line *A G*, must be equal to the distance between the line $o_5\ k_5$ and the same ground line; in fact, the lines $i_4\ m_4$ and $o_5\ k_5$ must lie in a line drawn parallel to *A G*. The same remarks apply to the lines $i\ m$ and $o_8\ k_8$, which are projections of the upper base of the prism.

We therefore have the following laws, which must always be observed when a plan and two elevations of any object are to be shown:

Points which in the front and side elevation represent one and the same point in space, must lie in a line drawn parallel to the ground line *A G*, thus: The point *i* in

the front elevation, and i_3 in the side elevation represent the same point or corner i_2 of the prism, and therefore the points i and i_3 must lie in the line $i\ k_3$ drawn parallel to $A\ G$, but since the ground line $A\ G$ is always a horizontal line, we may say that the points which in the front and side elevation represent one and the same point in space must lie in one horizontal line. To this law we add the one previously explained and frequently referred to, namely, points which in the front elevation and plan represent one and the same point in space must lie in a vertical line, that is, a line drawn perpendicular to the ground line $A\ B$. If these laws are thoroughly understood, and the principles by which the projections of points are found are also equally well understood, and remembering that the projections of straight and curved lines are obtained by finding the projections of some of the points which they contain, then the solutions of many of the following problems will be easy, otherwise they will be difficult and discouraging.

402. It must not be understood that in working drawings three views are always necessary. Two views of objects—particularly if they are simple ones—are frequently sufficient to show the true form and all the dimensions; but in general plans of machinery it is often necessary to show three views of the same, and in each one of these views a simple object, such as a nut, or a stuffing box, etc., may appear; and in such cases we must not only know how to draw the outline of the object, but we must also know how to assign to the outline of simple objects the correct position among the surrounding ones. Take, for instance, the valve rod stuffing box, shown in Figs. 285, 286 and 287. Here we notice that in the vertical projections, Fig. 286, we can only see one stud r, because we are looking at the stuffing box in the directions indicated by arrow 2, and therefore the stud r, and even the valve rod will hide the stud s. Fig. 287 represents the side view of the same stuffing box, and because this projection shows the appearance of the stuffing box when we look at it in a direction as indicated by arrow 3, both the studs r and s are seen, and therefore both are shown.

403. When two projections, that is, two views, of any object are sufficient to show its complete form, the third view can always be obtained from the other two views. Thus, for instance, Figs. 285 and 286 give the complete form of the stuffing box. These two views are sufficient to guide the workman in making the stuffing box; and since all the dimensions of the stuffing box are given in these two views we do not need any other dimensions for drawing the side elevation, Fig. 287, consequently the side view can be obtained from the two views given in Figs. 285, 286, and how this side elevation is obtained is clearly indicated by the auxiliary lines $t_1\ t_1\ t_1$ and $t_2\ t_2\ t_2$.

The distance between the side and front view depends upon the distance between the object and the vertical plane of projection, and also upon the distance between the object and second vertical plane of projection; thus: By moving the prism in Fig. 284 closer to the vertical plane of projection $A\ B$, the distance between the line $B\ D$ and the side elevation will be decreased; again, by moving the prism closer to the second vertical plane of projection $B\ F$, the distance between the vertical projection and the line $B\ D$ will be decreased. Now, since we can place the prism as close to the vertical planes of projections as we please, it follows that the distance between the vertical and side elevation is a matter of choice and good judgment.

Of course the outlines of the planes of projections, also the ground line $A\ B$, are never shown on a working drawing.

404. The shade or shadow lines in the side elevation are always placed similar to the shade lines in the front view or vertical projections, that is to say, the bottom and left hand edges of the flat surfaces are represented by shade lines. The reason for this will be given in a future paper.

Directions.—In the space marked 56 draw the plan and front elevation of the cylinder head, stuffing box and flange of cylinder, as shown in Figs. 288 and 289; in addition to these two views, and in the same space also, draw the side elevation; use 1½ inch scale. Our object in giving this mechanism as an example is two-fold; first, making a drawing of this kind is good practice; and secondly, it will familiarize the student with finding the proper positions of simple or elementary objects in the three different views. The positions of the studs in the stuffing box, and also the studs in the cylinder head in the side view, when compared with the vertical center line through this view, will not be the same as the distance between the vertical center line and the same studs in the front view. The student should be very careful to show all the studs in the correct position, and satisfy himself that he is right.

Since a drawing of this cylinder head, etc., made to a scale 1½ inches to the foot, requires considerable skill on account of its small size, and therefore will be difficult to execute, it will be advantageous to the student to draw this cylinder head to a larger scale on a separate piece of paper before it is drawn in space 56 on the regular sheet.

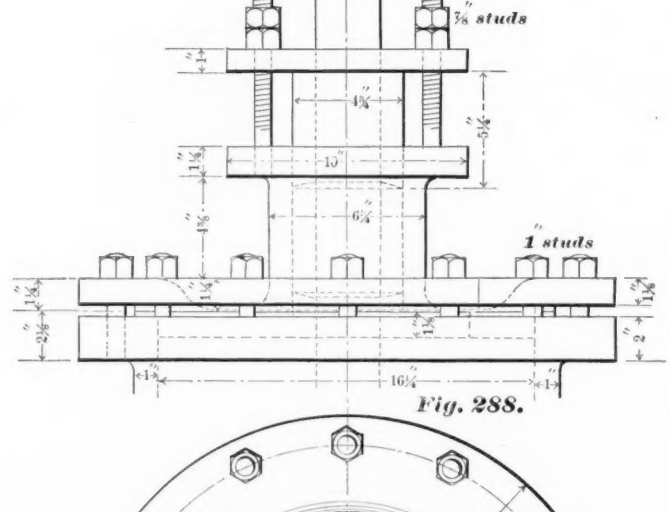


Fig. 288.

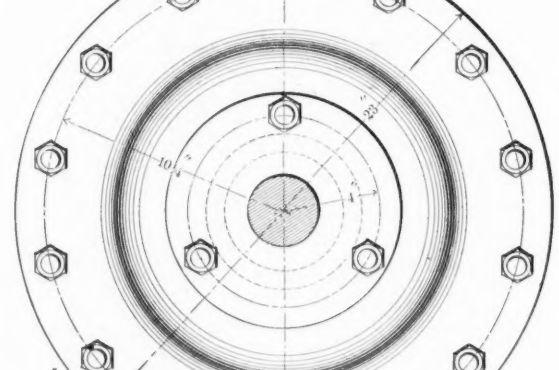


Fig. 289.

PRACTICAL DRAWING.—SEE PAGE 1.

Fire at the Rogers Locomotive and Machine Works.

On January 23d a fire occurred at the Rogers Locomotive and Machine Works, Paterson, N. J. The frame shop and the machine shop were partially destroyed. The extent of the damage—at the time this went to press—was not known, as debris, well covered with ice, had not been cleared away. The intention is to rebuild at once, and, since the extent of the damage may not be as great as first it was supposed to be, a serious delay in filling the contracts may be avoided.

The Argentine Republic imports to the extent of $50,000,000 a year, of which only one-tenth comes from the United States.

Early Engineering Reminiscences.

BY GEORGE ESCOL SELLERS.

THIRTY-FIFTH PAPER.

In about six weeks the nine months in which I was to have the guns in full operation would expire. I therefore wrote to Mr. Allen that the delay in getting the guns from the Novelty works to Evansville before the hostilities on the river prevented their transportation to our works, that even if then in operation the existing state of affairs would prevent obtaining a full supply of cane; that under the circumstances I did not see how it was possible to get into operation before the expiration of the time named in the agreement, asking a reasonable extension. To this letter I received a reply from Mr. Geo. F. Allen, stating that his brother Horatio was then in England, and that during his absence he was acting in his stead, but that before the expiration of the time his brother would be home, and he had no doubt that he would give the required extension; that I need be under no apprehension on that score, and that, should his brother fail to return at the expected time, he felt himself empowered to act for him; he would notify me of the time of his brother's sailing from Liverpool, and suggested my going to New York to meet him on his arrival.

During these long and unavoidable delays, I had lost no time in investigating the nature of cane stock as a paper making fiber, and in doing exactly what I should in common prudence have done, before accepting a theory, and, based on it, entering into a business requiring large outlays, intense labor, and no little invention in perfecting. In the first place I cut some stalks of green cane, cut them into sections between the joints, which I split into slivers, weighed with accuracy, and dried in an oven at 212°. I found considerable difference in the amount of moisture in these sections, between the lower and upper joints of the cane, but on the whole there was an average loss in weight of about 15 per cent., quite an item in transportation from the cane brakes to the works. Having a quantity of the tangled strings or bundles of fiber as discharged from the guns, I experimented on reducing it to the ultimate fiber and bleaching it. In this process I was surprised at the large quantity of almost impalpable dust of a non-fibrous character that went to make up the fiber strings; more than I imagined possible to fill the interstices between the fibers and bind them together. I attributed part of this wastage to the long drying of the masses of strings, that had lost strength and had become more brittle than when they came into my possession. I do not propose to go into the details of my investigations; they were elaborate, including critical microscopic examinations of the fibers in all conceivable stages, from the green cane to the ultimate bleached fiber. But I must confess that at every step I was losing faith, not only in the first explosive disintegrating process, but in the ultimate value of the cane fiber as paper stock when financially considered, owing to the great wastage, costly labor and expenditure of chemicals in its production.

But my investigations from the green cane were on a small scale, and the age and dryness of the fiber from the steam gun not in the most favorable condition. Therefore, until the guns were in position and worked to their capacity, no absolute, reliable results could be arrived at. To keep up my courage, I gave to the dry fiber the small scale of my experiments with the green cane the advantage of all my doubts, flattering myself that better results would be reached when I should get the guns and paper mill in full operation.

On receiving notice from Mr. G. F. Allen of the time his brother was to sail for home, I went on to New York, arriving there on the 31st of December. On calling on Mr. G. F. Allen, I learned that Horatio's time for sailing had been put off, but that he was then expected on the packet due the 14th of January. At this meeting with Mr. G. F. Allen I learned that there had been changes in the ownership of the Lyman patent, and a reorganization of the syndicate. He named to me some of the parties, and expressed his belief that they would prosecute the business on a large scale, and that, on his brother's return, I would have a proposition to make the works at our place the nucleus of a joint enterprise, backed by abundant capital. He asked me to think the matter over and be prepared to act.

On the 14th I was again in New York, and then learned that the time of Horatio's sailing had again been put off, and that he had only left Liverpool on the 10th; but the parties in interest had been informed that I was then East, and they had expressed a desire to see me and learn the progress I had made, and proposed that I should accompany him (Mr. G. F. Allen) to the office of the promotor and organizer of the new company. He assured me that I was to meet a gentleman of honor, and that I should be as free to explain to him what I had done and was doing as I would to his brother and himself. The party I was introduced to had evidently been expecting me, for he at once sent a boy to notify a member of the syndicate of my arrival. The conversation, until this party came in, was mainly in relation to the delay in forwarding the guns from the Novelty works, and the difficulties of having them transported on the Ohio, owing to the active guerrilla warfare; but when the associate came in—no less a personage than the British consul—questions were put, and notes of my replies written, in a manner that excited my suspicion that all was not right, and I declined answering any further questions or holding any intercourse until the return of Mr. Horatio Allen, as my dealings had been with him alone, and as trustee I looked to him as principal. At this juncture, Mr. G. F. Allen, who had stepped out when the associate came in, returned, and I got up to leave. Then the promoter who had been the principal spokesman went to his desk and took out the contract between Mr. H. Allen, as trustee, and myself, and, pointing to the date, asked if I was not aware that it was dated April 12th, and that the nine months

had expired the 12th inst. and this was the 14th; that he had Mr. A. as a witness to my acknowledgment that the works were not yet in operation, and that by the letter of the agreement I had no rights whatever; but, as honorable men, they did not propose to take advantage of this; but they had taken legal advice and were satisfied that, had I carried out my part of the agreement to the letter, that it was void, inasmuch as Mr. Allen had exceeded his powers in granting me the right to so vast a territory! But they were prepared to act toward me with great liberality and generosity, and proposed to grant me the free use of two guns, without royalty, provided I would, without litigation, release all claims under the agreement. At this aspect of affairs Mr. G. F. Allen looked surprised and much disconcerted. After leaving the office he expressed regret at having induced me to meet the promotor before his brother's return. He said he had attended all meetings, and thought it was clearly understood by all in interest that the extension I asked was to be granted, and also that the company would co-operate with me, as I was in New York, awaiting Mr. Horatio Allen's return.

On the 22d Mr. Geo. F. Allen again induced me to accompany him to the office of the promotor, assuring me that he had attended a meeting, and that everything was harmonious, and that the extension was to be granted. But instead of this I was met by the offer of the use of five guns instead of the two, and to show their great liberality in compensating me for the relinquishment of rights which they had legal advice that I did not possess, I was shown estimates of the enormous quantity of cane fiber I could shoot from these five guns, and that what I would save in royalties alone would be a real bonanza. Notwithstanding the great annoyance, I could not resist a smile at the sanguine calculations of "chickens before they were hatched." I declined accepting, but would await Mr. Horatio Allen's arrival, as the steamer he was on was then due. But I asked if I should accept their proposition, what assurances I would have that they, as a company, claiming to have command of unlimited capital, would not set up guns at every available point where cane abounded, and by underselling freeze me out.

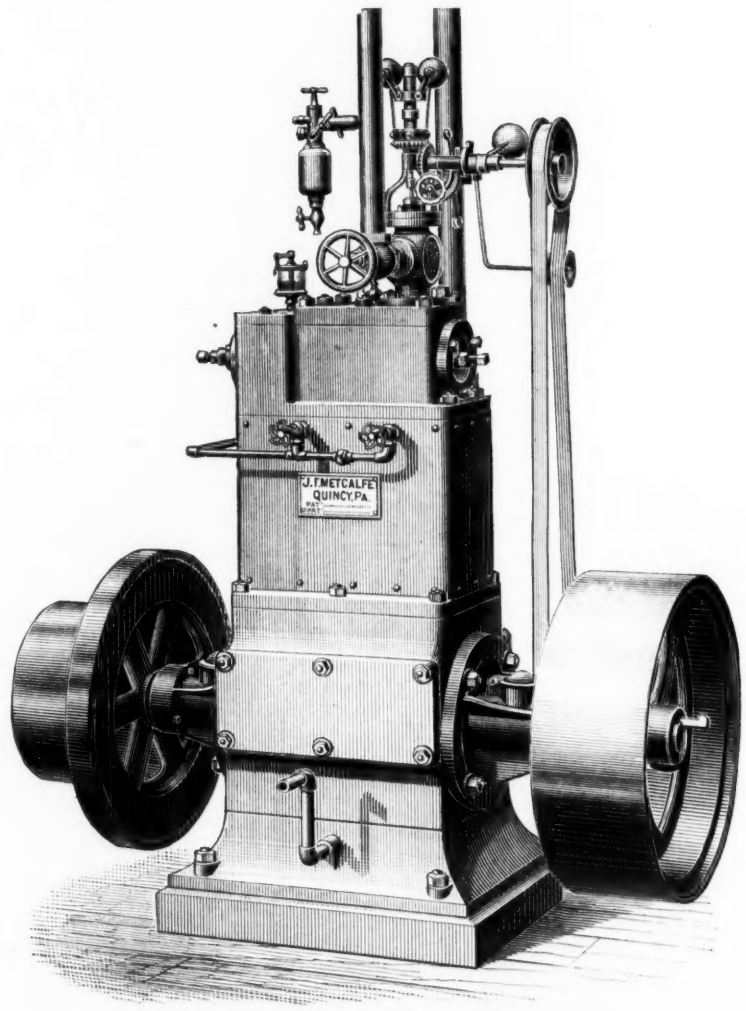
I saw Mr. Horatio Allen as soon as possible after his return. He had learned from his brother George the condition of affairs, and he promptly assured me that the extension should be granted, but before seeing the new parties he requested of me a written statement of the facts, which I gave him. He had no apprehension of any difficulty in having matters satisfactorily settled. But my experience with the promotor who appeared to have unlimited control was such that I proposed to Mr. Allen, that, for my protection, he should execute a written extension, and place it in the hands of some disinterested person; his son was suggested; to this he agreed.

After he had a meeting with the parties, he expressed himself as believing all would come out right; he suggested a new lease with some changes, and with the insertion of a *war clause*. I did not see any objection to the proposed changes—he favored what his brother had suggested, a union of interests and the extension of our works; but my associate in the enterprise, who had come on to New York and had several interviews with the promotor, was so disgusted at the manner in which we were being treated, that he positively refused any association. Many conferences were had with both Horatio and Geo. F. Allen; finally, all points in the renewed lease appeared to be satisfactorily arranged.

On the 5th of February, Mr. Geo. F. Allen, direct from a meeting of the company, called on me and assured me that everything had been agreed to, that I might consider it done; it would probably take a day or two to prepare and execute the papers.

On the morning of the 7th I saw Mr. H. Allen at the Novelty works, when he then informed me that he understood that the amended lease would be ready, and appointed 8 o'clock P. M., at his house, for me to read it, and if all right, to jointly execute it; at the same time he informed me that, as agreed, he had executed the extension and placed it in the hands of his son as a precautionary measure, needless now, as all had been adjusted to our entire satisfaction.

Not expecting any further difficulties, my associate left for Philadelphia. I accompanied him from the hotel to the Jersey City ferry. On my return to the hotel I found in my letter box what purported to be a legal notice to the effect "that Horatio Allen had been removed and the mastership invested in a Mr. Van Ness." At my appointment with Mr. Allen at 8 P.M. I took this notice to him. It was the first intimation he had, and he appeared thunderstruck. He promptly gave me a written declaration that he had, as agreed, executed an extension and placed it in his son's hands subject to my disposition, and he assured me that, if necessary for my interest, he would legally contest his removal. I subsequently learned that his assignment of his trusteeship was made and accepted at a later date.



THE METCALFE HIGH SPEED ENGINE.

Feeling secure in the grant, if there was anything of value in the gun process, I determined to carry out a full and fair trial as soon as a supply of cane could be had. I had learned from my son at the works that he had succeeded in getting the guns from Evansville and had them mounted in place ready for use; also that the paper mill was ready for operation. But it was not until the 18th of July, 1863, that a sufficient stock of cane was on hand to commence the gun process. On that date my first trial was made.

The guns were about 26 feet long, with an inside diameter of 12 inches. They were cast in two sections, and put together in the center by flange joints. The steam boiler was made of ½ inch iron double riveted, and 26 inches diameter by 40 feet long. The valves or doors of the guns were so hinged that when unlatched to discharge they would fall onto rubbber springs. To make the steam-tight joints a leaden ring was cast into a groove in the valve or door, which was drawn tight against the end of the gun by a latch catch, which, when hooked, was drawn back by a screw with sufficient force to form a perfectly tight steam joint between the valve and gun. The gun was discharged by raising the latch catch by a cord drawn by a man stationed at the breech end of the gun; the mechanical arrangement of the parts being as perfect as the nature of the operation would admit.

In prosecuting the first experiments the data given me was taken as a guide. For instance, ten minutes was given as the time required under a steam pressure of 200 pounds to so thoroughly heat the cane that when discharged into the open air the contained sap would flash into steam with such force as to rupture the cane in a manner amounting to almost a perfect disintegration; five minutes was supposed to be sufficient time to recharge and close the guns, or say four discharges per hour for each gun—that would give 80 for 10 hours' work of the two guns.

On the first trial the guns were steam-heated previous to charging with the cane, which was put up in tight bundles to fill their caliber. The steam was turned on with fully 200 pounds boiler pressure, which fell to about 170, and before it was again got up to the 200 pounds, 15 minutes from it being turned on had elapsed. On discharging, the result was a very imperfect disintegration. Some of the sections of the cane between joints were shredded into the long strings of fiber, but leaving portions near the joints including them almost entire; other sections were split into slivers or sticks doubled up, crushed and bent, evidently by their violent concussion against the target end of the gun room.

The time of submitting the cane in the guns to the steaming process was gradually increased up to 30 minutes, at which tolerably fair results were obtained. From this it was evident that a softening process requiring time was an absolute necessity, and from this I inferred that moisture as well as heat was essential, and that wet rather than dry superheated steam would produce the better results; by wetting the cane before charging there was a perceptible gain.

It soon became evident that the boiler was not adequate to working the two guns and keep up a pressure of 200 pounds; this was practically remedied by greatly increasing the grate surface, and using some well-seasoned hickory wood with the best quality of bituminous coal, but the expenditure of fuel was enormous when compared with the results produced. With this forcing process, by the middle of August I had succeeding in keeping up steam to work the two guns. Then commenced a series of unlooked-for troubles. First, the heavy flange joints uniting the two sections of the guns began to leak steam badly. The bolts that were fully adequate to carry a steady pressure of 200 pounds could not stand the jar or concussion of the discharge; in fact, it became necessary to bore out the bolt holes and substitute others of double the strength, and at the same time to securely anchor the carriages or frames the guns were mounted in. This would have been a small matter with a good machine shop at hand, but with only a blacksmith fire and small engine lathe, and only my own pair of hands and a poor helper, it was no mean job. But when done and again starting, having got steam up to about 220 pounds, the cast-iron ring seat for manhole plate that was riveted to the wrought-iron boiler head, split in two in a manner I have never been able to account for—steam escaped so rapidly that we were obliged to cool down. To make a pattern, send to the nearest iron foundry, cut out the rivets and rivet in a new ring, could not be done in less than a week. Some expedient must be resorted to. I enlarged the crack, inserted sheet copper, banded inside the boiler with screw clamp band, and outside shrank one on, calked the copper, and in a few hours after cooling down, was ready to go to work again, and by the 24th of August I had mastered all the steam leaks and got in fair working order, and by the 26th had managed to get 11 charges out of each gun in nine hours after steam was got up, say 22 charges out of the two guns, instead of 64, their estimated capacity.

The Metcalfe High Speed Engine.

The engine herewith illustrated is built by J. T. Metcalfe, Quincy, Pa.

It has two vertical cylinders placed side by side, separated only by sufficient metal to give the necessary strength and resistance. The cylinders are single acting, and are provided with hollow pistons, in length one and three-quarter times their diameter; the pistons are fitted with self-adjusting packing rings, the lower ring having only the exhaust pressure acting against it.

These pistons act as cross-heads, to which the upper ends of connecting rods are attached by means of hardened steel pins which are situated at the centers of the pistons. The crank pins are of hardened steel, set at 180° on the crank shaft, which runs in a closed chamber containing oil and water for lubrication. The supply of water is kept up by condensed steam from beneath the pistons, the height of water in the chamber being maintained by a siphon overflow. Oil is supplied to this water by means of lubricators placed on the crank shaft bearings.

Steam is admitted to and exhausted from the cylinders through a valve chamber located on top of them and forming top covers. In this chamber is a balanced rotary valve, worked from an eccentric, situated in the closed chamber, and connecting with a crank on the valve spindle through an opening or pocket at the side of the cylinder.

The valve can be adjusted, as wear occurs, with the engine in motion, by loosening a nut and adjusting the set screw at the end of the valve spindle.

A vapor pipe (not shown in the engraving) relieves the closed chamber from pressure that might otherwise accumulate.

These engines are made with either throttling or automatic governor, and in sizes from two to fifty horse-power.

In European countries, particularly in Germany, the importance of cutting lumber with thin saw blades is much better understood than it is in this country. As timber is growing scarcer here, the importance of reducing the wastage of sawing becomes more important.

Ethics in a Machine Shop.

By Jarno.

FOURTH PAPER.

1. Is it in accordance with correct ethics to make a machine to order, which machine, there are sufficient reasons for believing, will never serve any purpose for which it was designed?

If we cannot ethically make such a machine, then is raised the question, "What are sufficient reasons?" From a machinist's standpoint, there are two general answers to this question; either the purpose is mechanically unattainable, or, if attainable, the invention or machine will be inadequate for the attainment of the purpose—in either case the machine would have no value as a machine. Both of these reasons are based upon the question of mechanical success, and not upon the question "Is the purpose worth the attaining?" The commercial value of an invention might not be within the province of a machinist to determine.

There is oftentimes too much stress placed upon the fact that some mechanical successes have been achieved in directions that have been declared untenable by men claiming to base their opinions upon mathematical calculations. These achievements are cited in support of new schemes whose success is problematical. If, for the few inventions that have succeeded contrary to general expectation, we remember how many inventions are never heard of again, after they have reached the patented stage of their existence, we can but think that a little study of mechanical principles would have resulted in less unproductive effort.

While it may be commonly admitted that we shall yet have more surprises in the way of inventions and discoveries, yet there are principles so well known that it is no longer a question as to their effect in the modification of the action of machinery. These principles can be set down as mechanical laws which we cannot violate without paying the penalty.

When a machine is to be made in violation of mechanical laws, we can predict its failure with greater certainty than we can when it is merely to contain an untried combination of mechanical movements.

For all the purposes of practical life we may be sure that the iron and steel of the future will not be stronger than the iron and steel of to-day. It is certain that with a pump we cannot draw water through a vertical height of more than thirty-four feet.

Of all the impossible things ever attempted by man, none are more vain than the attempt to obtain perpetual motion. If it were possible to make a machine having perpetual motion, in the ordinary sense of the term, then for more than two centuries there has been a mistake in declaring the first law of motion.

Occasionally we are asked to make machine parts dangerously weak.

Not often is the attempt made to draw water through a height of more than thirty-four feet.

Although impossible to obtain, yet perpetual motion has been attempted by mechanicians and mathematicians of considerable note. Most mechanics graduate from their earlier teens and from their hopes of obtaining perpetual motion at about the same time. Occasionally the perpetual motion idea holds over into a man's riper years. There are but few machinists who have not been approached by the man who thinks he has invented a machine that will run by perpetual motion. Such an inventor should be told that his perpetual motion scheme is contrary to mechanical law, but after telling this to him, if he insists upon having the machine made, can a machinist ethically make the machine? The considerate judgment of mankind will be that such a machine should not be made. We expect most from him who most knows, and we should expect a man not to make a machine when he knows it will never work.

The part of a man's education that is obtained by experience may be as prominent in thought and as permanent in memory as any other part of his education. Some men will not accept the experience of others, and hence any deductions from the experience of others is to these men equally unacceptable. The perpetual motion man may ask to have his scheme worked up, on the score of his obtaining more knowledge of mechanical laws. This might appear reasonable if he is worthy of being educated. Yet it matters not what he may say—that he is willing to pay for his education—will not complain if the completed machine does not work—he really thinks it will work, if fairly tried—and it will be difficult to make him feel that it has been fairly tried. If he does finally learn that there can be no such thing as perpetual motion, he, very likely, will think that the machinist should not have acceded to his wishes in making the machine. Hence, considered merely as relates to the two parties, it is better that the machinist does not humor the inventor.

But there is something deeper and broader, that covers the relation of the individual to the community. Ethics coldly gives a standard according with the average decision of all men, that is not mechanical, not commercial—a standard that, in the interest of any one, warms not, changes not.

Men in mechanical life should have the same dignity in their calling as men in professional life.

A physician should not prescribe poison for his patient merely because his patient asks for poison.

He who erects an unsafe building is liable to be punished. We feel that some one is guilty when a railroad bridge proves to be weak. Correct ethics and the spirit of the law agree that some one is to blame when any structure fails of its intended use and the failure endangers life.

Now in filling orders, if the limitation to what may be made is at the line where life is endangered, there may be nice distinction. If a customer insists upon having a pump placed more than thirty-four feet higher than the water, after being told that a pump cannot draw water so high, and the pump is so placed, life may shortly be endangered in case of fire. Suppose we are ordered to make car wheel axles of cast-iron?

The machinist, in common with other men, expects many things of the State. He expects the State to build school-houses and employ teachers, to build bridges and keep the roads in repair. In return there must be a place where a man's financial gain becomes secondary to the interests of the community. The progress of the community requires a man to make better use of his time than to spend it upon perpetual motion projects, upon fire hydrants that will not draw water, or upon cast-iron car wheel axles.

A man does not act ethically, who, merely because he is paid for it, knowingly does a thing that can result only in loss to others, even though he gives due warning.

2. All letters from a concern should fairly represent the intent, purpose, or opinion of the central authority. Under this general statement I will consider two or three of a variety of cases. The varieties are as numerous as the subjects upon which a concern writes. As they are all affected by the method of disposing of correspondence, I will place them in one class.

Cases in which the secretary or clerk writes upon mechanical subjects or shop matters require careful handling. In some establishments, the secretary goes into the shop to obtain information upon the subject of a letter to be written. He finds the foreman or workman who can give the information, gets perhaps a fair understanding of what is intended to be said to him, and then returns to the office. He writes the letter from memory. The letter is mailed without being submitted for examination and correction to the man who gave the information. Now the writer ought to be certain that his informant is reliable. This is of special importance when the informant is involved in the case. Then the writer should make sure that the letter accords with the opinion of the informant. A slight variation from what the informant intended to say may lead to annoyance and vexatious delay. In other establishments, the better practice is to have the man who is responsible for the subject matter of a letter, write what he has to say. This writing is copied in the letter, and is then returned to the man. If, in the office, it is thought better to change the diction, the man is consulted. When the subject is important, and of such a character that the secretary does not care to spend the time that would be necessary to obtain a knowledge of it, the man who is responsible for the subject matter is required to sign the letter.

I was in the office of a machine shop as

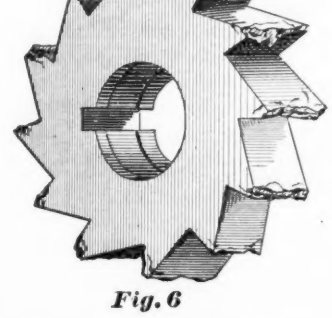


Fig. 6

the proprietor was opening his mail. He showed me a cutter broken as in Fig. 6.

He said that his customer expected a new cutter in place of the broken one.

"Am I to understand that your customer asserts that this cutter has had fair usage?"

"His letter states that the cutter was so hard that it broke as soon as it touched the work."

"There is no doubt but it broke as soon as it touched the work, because it was run backwards."

"Yes, the cutter's evidence against the man who tried to use it is conclusive."

"How do you dispose of such a case?"

"I will send a new cutter without charge. With it I will return the broken one. In my letter of advice I will ask my customer if he will kindly take both cutters to the workman and ask the workman to examine the broken cutter. I will then ask that the workman be told how careful he must be not to run the new cutter backwards.

"The typical story of this cutter is: the workman who broke it reported to the foreman, the foreman took it to the office and gave his own version of the workman's report, the secretary wrote this letter and returned the cutter without looking into the merits of the case.

"Now when my letter is noted, there will be asked some pertinent questions. Advice will be given in such emphatic terms that it will hardly be distingushable from a command.

"The statements in the next letter I receive from this concern will resemble fact so closely that one will suggest the other."

"Do you think it possible that the workman did not know he was running the cutter backwards when it broke?"

"Yes, I have known this blunder to be made in my shop. The workman reported that something was the matter with the cutter. He did not see what he was doing until it was pointed out to him by the foreman. I suppose that most of us make this mistake once in our lives. To make it once in a lifetime is enough."

"Why do you give another cutter, without charge, when you are certain that the cutter broke through no omission of yours?"

"If a man does not or cannot see the correctness of a decision that is not in accordance with his preconception, then the decision does him but little good. It is better not to be particular, so long as a customer really thinks the ethics of the matter is on his side.

"The requisite hardness or temper of anything made of steel, is something on which men may honestly differ, though it is subject to experimental proof. The workman who blunderingly broke this cutter thought it was too hard. Cutters that had not been tried at all, have been returned to me, as being soft, simply because they could be scratched with a file. The cutting property of files is not an absolute standard. I have some files made specially hard because they are used where they come in contact with hard steel. These files last from two to four times as long as other files, but they cost more than other files.

"In my tap and die department, I have made it a rule to give every customer a new tap for a broken one, when he returns the pieces. Generally, men know where the ethical line is and will act up to it when they are required to bring in the fact pieces. Since I have required all the pieces of a broken tap, there has seldom been one returned that I did not want to have returned. If a tap takes a permanent twist before it breaks, it is too soft. Of course, the pieces show whether or not a tap was defective from fire cracks. When we let a man see that we intend to act upon ethical ground, we give him an incentive to look to it that his line of action is within ethical limits.

"When a man does not apprehend the evidence of the pieces, as was the case with the man who returned this cutter, it is well to help him by letter. A suggestive letter may lead him not only to apprehend, but also to comprehend."

As I left the office new thoughts came to me. This man had a somewhat distant air, yet a certain geniality of manner. He seemed to understand the motives of men and to have a measure of their capacity. There was a cold and searching logic leading to his decisions. Under the polite wording of his letter there may lurk a sarcasm more incisive as the letter is re-read. Sarcasm is the more effective as it comes in the garb of politeness. All men like to have the good opinion of others, yet most men will not accept the criticism of others as a standard. This man's opinion would have weight wherever he is known. Those that know him are careful in writing to him.

It is well to be careful in writing all letters, whether or not the recipient is known. In general, it is better to leave important letters not sealed for a few hours and then read them carefully before sealing them.

A concern may be rather free in giving recommendations. No letter is less likely to represent accurately the real opinion of a concern than a letter of recommendation. Somebody wants a recommendation for a supply article or device, for a self oiling loose pulley or the oil that is put in the pulley. The secretary takes but little pains to learn the facts. He may not even find the man who has tried the article. He, perhaps, sees some one who knows where the article has been used or where it may be found. Not hearing anything against the article, after not really trying to learn accurately anything about it, the secretary writes a recommendation. A salesman tells me that any one can obtain a recommendation from this concern. It soon gets a reputation for making loose statements.

Hardly more care is taken in recommending men as to character and ability. An employe leaves on account of his belief—believes that, if he does not go, he will be discharged. He gets a recommendation. In order to let him down easy, the concern will even go so far as to recommend him for a position similar to the one he has just failed to fill.

Now I do not assert that in freely giving recommendations there is a conscious shortcoming in ethics. It may be said that the motive is to help others. This would be an extenuation, if the concern helped others at its own expense. It is an extenuation that these recommendations are meaningless, when presented in machine shops of the better class, as no one is then misled. But even this extenuation rests upon the basis that, when a man is making an erroneous statement which he does not expect any one to believe, he is not telling an untruth. The soundness of this basis is doubtful. In shops of the better class, when an applicant puts his hand into his inside coat pocket,

the employer at once says: "Do not show me your recommendations; I have no time to read them, and, if I did read them, they would not influence me in forming my opinion."

A man who tries to obtain employment on the strength of a recommendation is not conversant with the practice of the best machine shops.

The generality of recommendations have no more value than once did the diplomas of a certain medical school in Pennsylvania. This noted school is said to have given a diploma even to one of the sweepers. Like certain patents, these recommendations are a by-word and a wagging of the head to mechanics.

Yet, as there still may be shops where a recommendation would mislead, it is better either not to discontinue them or be more careful in writing them.

Ethically, no censure would be attached to a man who carries a recommendation in his pocket, if it helps to make him happy. Men have hoped in things less tangible than a recommendation.

The best shops are chary of their recommendations. They have a reputation for making accurate statements, and commendatory letters from them are in demand.

A difficulty in giving recommendations is that it is not known how soon the conditions may change. A self-oiling loose pulley may run for months, and then suddenly become a *tight* pulley.

After a concern had given a recommendation, with the usual precautions, things transpired compelling a modification. This cost the writing of more than one hundred letters of explanation.

Let the same care be taken in writing all letters that would be taken in making a machine. Letters, like machines, are things tangible. Machine shops are judged by their correspondence as well as by their manufactured product.

Shop Notes.

We called recently at the shops of the Richmond City Mill Works, at Richmond, Ind., and found them in good shape, and getting ready for the year's business.

Mr. P. Shellenback, the foreman of the machine shop, is introducing several improved methods of doing work. Among other devices is an extra head mounted in the center of the rail of a boring mill. This head is fitted with a revolving boring bar, by means of which a pulley or wheel can be bored at the same time that the other two heads are doing the turning.

This concern makes a practice of getting out complete working drawings of every outfit furnished by them—a practice which necessitates the employment of the unusually large proportion of one draftsman to every 16 men employed in the shops.

Tracings are made from the pencil studies, and blue prints made from these tracings are used, the tracings being indexed and preserved. By this means any part of any outfit may be duplicated upon an order by telegraph, the shop work being kept to standard for that purpose.

At the Atlas works, Indianapolis, they are making a good many moulding machines, in addition to their regular business in engines. Mr. Reuff, the former foreman of their machine shop, is now in Europe, introducing their moulding machines.

In these shops the blue prints are all reduced to uniform size for use in the shop, and kept in a department of the tool room; from where they are checked out by the workman, the same as tools. These blue prints were formerly mounted upon heavy cardboard, made for the purpose. There were some objectionable features about it, and after considerable experimenting, a roofing material, made of wood pulp, was finally found, which they are now using, and consider it unequaled for the purpose.

It is stated that in the great Krupp works at Essen, there are forty-two miles of telegraph lines, with forty telegraph stations and sixty Morse instruments.

Micrometer Caliper Square.

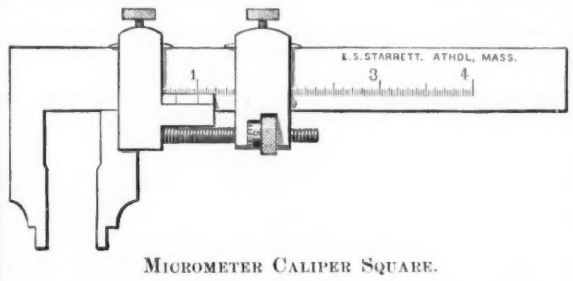
The cut presented herewith shows a new tool, made by L. S. Starrett, of Athol, Mass.

The intention has been to combine the valuable features of a graduated caliper square and those of a micrometer caliper.

One side of the beam is graduated to 64ths and the other to 40ths of an inch.

By means of the screw and micrometer nut the sliding jaw may be moved either way from any given position, by .1000 of an inch.

Around the screw, and between the sliding jaw and the clasp, is placed a spiral spring, which always tends to separate them, and thus takes up all slack or lost motion between the nut and clasp and in the threads of the screw.



MICROMETER CALIPER SQUARE.

Then, if desired, the binding screw of the sliding jaw may be left slack, in which case the pressure of the jaws upon the work will be limited by the compression of the spring, and thus the springing of the jaws in calipering be avoided.

The jaws are $1\frac{5}{8}$ inches long, are hardened, and open to 4 inches; the beam being graduated to a sufficient length to enable work of that size to be calipered.

Comparative Freight Charges.

Engineering, in a recent article comparing American with Indian railways, shows by figures and statistics that freight is carried over American roads much cheaper than over those of India, notwithstanding that the first cost of the roads is about the same, that the Indian roads have much the more level country to run over, and the cheapest labor in the world.

It fails to find a satisfactory explanation of this state of affairs, but we suspect that it is only another illustration of the fact that "cheap labor" is not cheap, when it comes to employments requiring any degree of intelligence; and there are few employments connected with railroading in which a considerable degree of intelligence on the part of employes would not be of decided advantage to the road's owners.

Such intelligence cannot be secured nor developed unless the wages paid are sufficient to enable the men to live as it is necessary for intelligent men to live in order to retain intelligence and transmit it to succeeding generations.

In a recent number of one of our scientific contemporaries, a prominent place is given to a cut and description of a very unscientific combination of a rocking chair, a train of gears, and some wheels, by which it seems to be expected a person will be enabled to rock comfortably, and at the same time, and, in fact, by the same motion, propel himself over the country "at a high rate of speed, without much exertion."

We should judge from the appearance of this wonderful contrivance that it would weigh about as much as a "modern improved" hand-car, but it is far more complicated. The tires of the wheels are about five inches wide, and there are eight gear wheels in sight, and a fly-wheel weighing, we should judge, about one hundred and fifty pounds. The apparatus resembles in appearance an invalid chair, but the man who should sit in it and rock himself over the country "at a high rate of speed" instead of being an invalid, would, we think, be worthy of the name of the Modern Samson.

Expecting to do a good deal of work "without much exertion" has wrecked a good many inventors.

One of the latest canards comes from Pittsfield, Mass., in the shape of a special dispatch, which states that a process has been discovered by which scrap iron can be converted into copper at a cost of eight cents per pound.

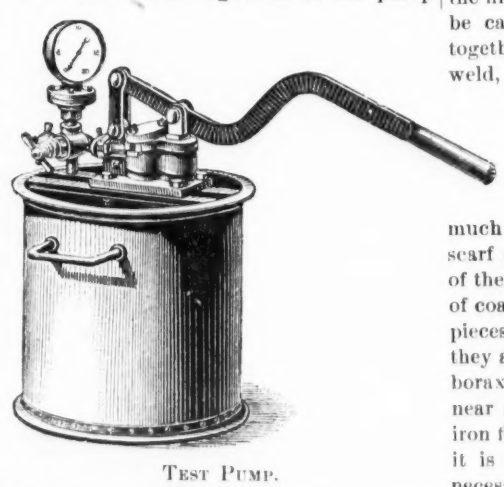
If it should happen that any of the men who are now cornering the market in copper and its alloys should believe this story, and be led thereby to unload, then this "discovery" might be of some use; at least temporarily.

The announcement is made from Pittsburgh that the nine-ton steel casting has been drawn from the sand, which, when bored and finished, it is hoped will demonstrate the practicability of making guns composed of a single steel casting, instead of building them up of a series of steel rings, shrunk on, in order to impart the necessary tension to the outer portions of the tube.

So far as appearances go, the casting is pronounced to be perfect, but only the final test with powder and shot will determine whether or not the process is successful. If it proves to be so, then something of a revolution will probably take place in the manufacture of guns, because, by this process, they can be made much cheaper, and the cost of killing people somewhat reduced.

Test Pump for Boilers and Pipes.

The accompanying illustration represents a new pump brought out by P. F. Hoppe, 109 Liberty street, New York. It is used for testing boilers and pipes by water pressure. The pump itself is an ordinary force pump, and the new features in this design consist in the attachment of the pressure gauge and water tank to the pump, making in the whole a very neat and compact arrangement and very suitable to the purpose for which it is designed. Since this pump is not intended for the purpose of filling boilers and pipes, very little water will be required for testing, consequently the tank capacity is made correspondingly small, thereby reducing the weight. Hence on account of the lightness of the pump and attachments it can be readily carried from place to place, wherever required, and on account of its completeness and simplicity, it is always ready for use and can be quickly attached, and the boiler or pipes tested.



TEST PUMP.

Now we are told that the large guns which it is proposed to make in this country will be quite useless against recent armor plate. We, so it is said, must try again. It is the old question of the irresistible force and the immovable body. The same question crops out in mechanics. A lathe or a planer is always wanted—and always will be—that will take a larger cut. So there will always be wanted a gun with more powers of penetration.

No one has ever satisfactorily explained why the signature to a plainly written letter is frequently undecipherable.

LETTERS FROM PRACTICAL MEN.

Blacking Metals.

Editor American Machinist:

In a recent issue I observe a query from one of your correspondents as to a method for blacking metals. I have lately been struggling with that problem myself, and find that manufacturers of optical instruments and others who use such processes are inclined to be more or less secretive about their methods.

Not being able to get a formula from any of them, or from any text-books, that would give the desired result, I have ventured a few experiments in that line myself. I got very good results from the following:

4 drachms nitric acid,
8 " water,
6 " chloride of gold (solution of 15 grains gold in 15 ounces water).
12 grains of nitrate of copper.

This bath was used warm. The brass articles were thoroughly cleaned and immersed until they assumed a purplish black color. They were then allowed to dry overnight without being washed or wiped.

This process gave a dead purplish black which would not rub off. It was afterwards improved somewhat by giving it a coat of very thin lampblack and turpentine, which dried immediately, and was then wiped off with cotton.

The proportions of chemicals are given just as I first tried them; possibly better results might obtain if proportions were varied.

I have also thought that a good even black color might result from sensitizing the articles, in the manner in which photo-plates are sensitized. Then expose to light and develop the black with iron developer. I have not tried this plan, however.

F. A. HETHERINGTON.

Welding Steel.

Editor American Machinist:

I have been a constant reader of your paper and have profited much thereby. In hopes that the following notes on welding steel may be of interest to some of your readers, I offer them. All practical steel workers know that with some kinds of steel it is very difficult to make a solid weld. In the first place the two pieces of steel should be carefully scarfed, so that they will fit together well when taken on the anvil to weld, and, when practicable, a **V** scarf should be made, or, to make it, plainer, split one end and point the other, and put together before they are put in the fire for the welding heat. This way of scarfing is much better, for by so doing the outside scarf can be hammered up close to the heel of the other scarf, so that dirt or small pieces of coal from the fire cannot get between the pieces of steel. I heat them slowly until they are an even cherry red, then apply borax and bring the heat slowly up to pretty near a welding heat. Then take some soft iron filings and sprinkle over the steel where it is to be welded, put on more borax, if necessary, and bring it up to a welding heat. By the use of iron filings a much stronger weld can be obtained than by borax alone. I have tried several kinds of welding flux and other preparations for welding steel, but have never found anything so sure as wrought-iron filings and borax.

Ice in Steam Pipes.

Editor American Machinist:

J. Torrey asks if steam at ninety pounds pressure will thaw out one foot of ice in an underground pipe, and in answer will say that it would very quickly, provided the steam got there, which is very doubtful in such a case as this, owing to a lack of circulation. Any pressure would do the work, but the higher quicker, owing to its greater temperature.

I am in charge of a plant where steam is distributed to various buildings, some by overhead and some in underground pipes, and at a distance of 800 feet from the boil-

ers in a few instances. I have found that it is best not to put steam into the pipes until they are free from ice. I have also found that pipes can be burst as surely by careless thawing as by frost. The only safe way to thaw a pipe is to commence where you know the pipe is *not* frozen, and work toward where it is with hot water, or other means, for if you thaw a place where there is frost both sides of it, you run a risk of bursting the pipe from the pressure of the expanded water confined between the solid joints. There is also danger in turning steam into long lines of pipe in very cold places, for more or less water always precedes the steam, and this coming in contact with the frosty iron soon falls in temperature to the freezing point, and will congeal solid only a few feet in advance of the steam. This I know from trying the experiment with 200 feet of 1″ pipe laid on boxes out of doors, and with a fall of one foot in 200. With the temperature 8° below zero, and steam at 40 pounds pressure, the pipe closed tight at a point 145 feet from where the steam was let on, and the pipe was too hot to handle to within 25 feet of the point that froze.

I have found the only safe way to be to either put the pipes where they will not freeze, or to keep up a circulation of steam in them. This, of course, refers to heating pipes of small sizes, as the above could not occur in larger sizes used for conveying steam.

Peter H. Bullock.

Making Conical Spiral Springs.

Editor American Machinist:

W. W. J., of Baltimore, can make conical spiral springs in the following manner with ease and facility. Wind the springs in usual manner on a straight mandrel and close the ends back, the distance required for the cone, by bending the coils in the jaws of a vise. Commence with the end coil and squeeze first on one side and then on the other, until it is somewhat reduced in size; then take the next coil, and so on as far as you want to go. Be careful to squeeze the coils in such a manner as to retain their circular form. It is best, in order to get good results to go over the cone a number of times, instead of reducing each coil to the required size as you go along.

Chas. Pratt.

Oneida, N. Y.

Removing Iron Turnings from Babbitt Metal.

Editor American Machinist:

We have a considerable quantity of Babbitt metal mixed with iron turnings which are thoroughly incorporated with it. Can any of your ingenious readers suggest a plan for removing the iron from the Babbitt?

A. B. C.

Another Slotting Machine Bar.

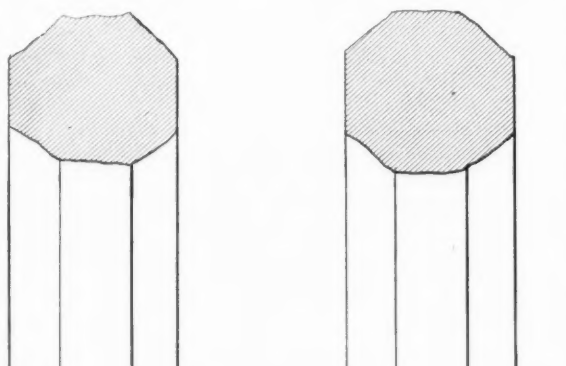
Editor American Machinist:

In your issue of January 21st I note a communication from A. S. Bergh, with illustration of a slotting machine bar therein described. There are, however, serious objections to this tool as shown; moreover, it is very far behind the age; and I think that perhaps some of your readers may profit a little by a description of a similar bar made by me as long ago as 1851 and used on the first slotting machine introduced into this country.

The machine in question came from the works of Joseph Whitworth, England, in 1849. I have no doubt but that the identical bar constructed by me in the year mentioned is still in use, as I know of its continued use, as well as several duplicates of it, for about ten years, at the expiration of which time it was practically as good as when first made.

The bar was a plain, straight octagon, as shown in the figures, slotted through equal in width to one face of the octagon, and without any member at the bottom to tie the two sides of the slot together, as in Mr. Bergh's bar. The fulcrum pin was placed back of the center, as shown; and the tool slot in the oscillating box, cut so as to encroach upon the fulcrum pin about one-half its diameter.

The objects of this construction were: First, to bring the line *a a* as nearly right angled to the axis of the bar as possible, in order to avoid chattering and the tendency of a dull tool to push away from the work, if *a a* makes very much more than a right angle with the bar—as will be readily understood by every mechanic using a planing machine or a shaper—and as seen in Mr. Bergh's bar, the angle in the latter being shown by the dotted line *a′ a′*. The next object was to permit of the bar being placed in the tool box of the slotter slide at eight positive positions, and, with a comparatively small projection of a cutting tool out of the bar, to permit of working both ways into a corner, as shown by dotted lines *b b* in plan view.



Slotting Machine Bar.

A round shank, as shown in Mr. Bergh's bar, is objectionable as being difficult to set in an ordinary tool box of a slotter in any chosen position, and to hold firmly when so set, while the square lower end will not permit of the bar's being used in a corner, as shown for the octagon bar, without projecting the cutting tool from it an inordinate amount.

Ten years' use of the bar described proved its strength and durability, and application to a great variety of work.

John T. Hawkins.

Taunton, Mass.

Making a Pattern for a Cylinder Bushing.

Editor American Machinist:

While making a pattern for a cylinder bushing, I thought it would be interesting to some of your readers to know how I made it, that it might leave its own core. The size of casting rough from foundry, 16½″ inside × 18⅝″ outside diameter × 2′ 9″ long. First, I made a full size drawing, allowing shrinkage and draft. Also divided it in four sections lengthways, seen at Fig. 1. Then I described the two circles seen at Fig. 2. Also a pattern of segments struck with the same radius and cut to the length of ⅛ of circumference + ⅛″. After sawing the required number, which was 408 pieces, previously planned ½″ thick, I prepared to build section 1. A face plate of pine was trued up, and circles, Fig. 2, transferred to its face. Next we joint enough segments to make two courses. The method is understood by referring to Fig. 3. Stop *b* is screwed on eccentric and can be adjusted to suit by rotating either way. Now commence to lay them down on Fig. 2, starting by keeping end of 1 fair with line *a*, and proceed until 5 is in place, then remove 1 and lay on 6. Mark the length which will be at line *a*, and cut to length, and number them. Gather them up and size the ends with glue; lay aside and prepare another course the same way. Now fasten them to face plate by gluing it where segments belong, quickly lay them in place and glue the upper face. Then lay the second course in place, wipe off surplus glue from face, and put under pressure, but first oil the follower. Prepare two other courses; by that time you can remove from press and glue again. I do not nail at all.

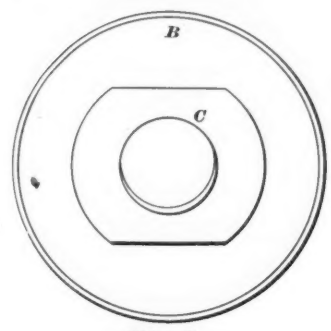


Fig. 2

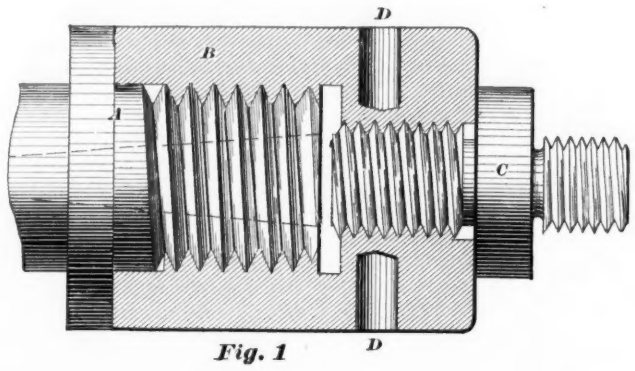


Fig. 1

Handy Nut Arbor.

Cylinder bushing pattern.

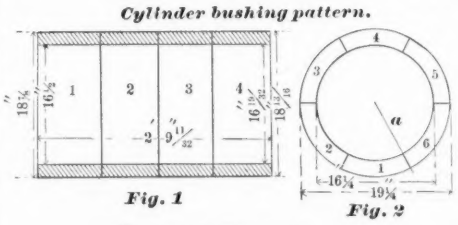


Fig. 1 Fig. 2

Cylinder Bushing.

Before I begin to turn I glue up section 2 on a separate face plate. The sizes are taken at the division lines with trams and transferred to outer edge whilst the end at face plate is sized with calipers. When ready the length is taken with dividers and marked, then cut nearly through with parting tool; finally sever with a saw and level with plane.

I find I can secure better joints this way than to fasten with screws and paper between. When all is turned and glued together, a scraper is all that is needed to clean off the joints. But you will see that it needs careful work, so that the finished pattern shall be straight both inside and out. If one is not careful to prove with square, or otherwise, whilst building up the courses, there is danger of letting them draw over to one side, and the result will be you have not enough stock on one side and too much on the other.

I generally give such pattern a coat of quick-drying paint made of white lead, thinned with a little varnish and turpentine (no oil), with lampblack to darken. It does not raise the grain like the first coat of shellac when applied to clean wood. Painters' hard putty can be used to stop where beeswax would otherwise be used; then give two coats of shellac to finish.

W. Newton.

Handy Nut Arbor.

Editor American Machinist:

I enclose you a sketch of a very handy nut arbor. In Fig. 1, *A* represents the lathe spindle, *B* the holder and *C* the arbor; *D D* are holes drilled for a spanner wrench, which is to be used for removing the holder from the lathe spindle. The arbors *C* are made of tool steel and hardened when finished. The holder *B* is made of cast iron, with one end threaded to fit the lathe spindle, while the other end can be tapped any convenient size, say one and one-quarter inches.

A full line of arbors can now be made like the arbor *C*, Fig. 1, with two sides milled off so as to be parallel, as shown in Fig. 2. The arbors can then be removed from the holder by the use of a wrench. The first cost of these arbors will be a little more than the ordinary style of nut arbors, but they will be found more convenient, as they dispense with the use of dogs, and with the screwing up of tail stock spindle. With a few forming tools to shape the nuts with, they will do ten times the amount of work.

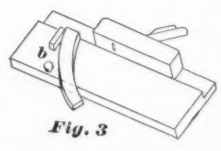


Fig. 3

J. L. Oefinger.

Relative Cost of Milling and Planing.

Editor American Machinist:

Mr. John J. Grant makes quite a showing in favor of the milling machine by the figures given at the Philadelphia meeting of Mechanical Engineers. I have no desire to question the accuracy of his figures, but I must question the conclusions he draws from them. I pass his tables of cost for a moment to where he says "Common sense teaches that a continuous rotary motion will produce more work than a reciprocating or intermittent one." If common sense teaches any such thing, it teaches one of those things which we often find out to be false. It may be easy to say that a rotary cutter, moving all the time in one direction, with no time lost backing up for a fresh start, will do more work than a tool which loses one-third of the time dragging back over the work. It looks plausible. An eminent mechanic once said in the columns of the American Machinist, "An attempt to cut gearing on a planer will let the light in on the milling machine question." An attempt in that direction did let in some light, and that light showed the superiority of the planer for that class of work.

Mr. Grant's statements give 89 hours and 18 minutes as the time required to mill 100 pieces, and 49 hours and 10 minutes as the time occupied in planing 100 similar pieces—a small showing, I think, in favor of the rotary cutters.

I do not know why the feed of about 22 cuts per inch was the coarsest that could be

used, but it was a much finer feed than I have been accustomed to use on most of work. I do not see the justice of paying the milling machine man 9 cents per hour, and the planer man 25 cents per hour in the case cited. An apprentice, or a 90 cents a day boy, can learn to attend a planer on plain work as quickly as he can a milling machine.

Had the milling machine hand received the same pay that the planer hand did, Mr. Grant's figures would have stood something like this:

MILLING MACHINE.

44 hours 39 minutes, @ 12½ cents each	$11.16
Sharpening cutters	.11
Shop expenses @ 35 per cent. of labor	3.94
Total cost	$15.21

PLANER.

*24 hours 35 minutes each machine @ 25 cents	$6.03
Grinding and setting tool	.33
Shop expenses, 35 per cent	2.22
Total	$8.58
Cost of milling 100 pieces	$15.21
Cost of planing "	8.58
Balance in favor of planer	$6.63

Had a boy at 90 cents per day attended the planer, his account would have been:

24 hours 35 minutes, two machines, each @ 4½ cents	$2.21
Grinding and setting tool	.12
Shop expenses, 35 per cent	.82
Total	$3.15
Subtracting, as before,	
Cost of milling 100 pieces	$5.49
" planing "	3 15
Balance in favor of planer	$2.34

This, of course, shows the planer at its best. There are, I know, many kinds of work that cannot be done to any advantage on a planer, but I also know just as well, that any work that can be done on a planer can be done as quickly and as cheaply as on a milling machine.

Then I do not consider Mr. Grant's comparison between the cost of grinding on the planer and on the milling machine to be a fair one.

The planer is as justly entitled to the use of the most modern tools, and the grinding machine, as the milling machine. There are planer tools on the market that require no forging, and less grinding than a forged tool to resharpen when dull. Such tools would do away with the loafing in the smith shop and the grinding by the planer hand, and put it in the tool room expense, beside the milling machine grinding.

There is another thing that must be looked at, though it would be hard to find the exact expense in each case. The milling machine requires a great deal more power to remove the same amount of stock than a planer.

Mr. Grant's examples of cheap cost of production I have no desire to criticize, except the cost of finishing the apron mentioned. He states the actual cost to be seven cents. This I think must be a misprint.

In a regular line of manufacture on the interchangeable plan, and no other ought to be adopted, the milling machine stands at the head on small and irregular work, but on general shop work, engine, saw mill and mining machinery, where most of the work is heavy and plain, the rotary cutter cannot compete with the reciprocating one.

Mr. Grant attempts to show that the planer and the milling machine are rivals. This I deny, and claim that each has its own field of usefulness, and that work suitable for one should never, unless absolutely necessary, be put on the other. They are no more rivals than the lathe and the boring mill. I may have put my foot in it by attempting to criticize the statements of a man of Mr. Grant's well-known ability, but I believe fair tests will bear out my conclusions.

F. L. JOHNSON.

*Mr. Grant's figures.

"The Use of Calipers."

Editor American Machinist:

In your issue of January 14th I see Benj. F. Hetherington's criticism on my letter of December 24th on "The Use of Calipers," in which he says I seemed to dwell at some length on the method of adjustment, and that I failed to state what constituted a good pair of calipers. There is certainly a fund of amusement in his description of the style of calipers his "boss" threw across the shop because his inability to set them exhausted his patience and brought forth the remark that "such calipers were only intended for lazy people." Now, I consider this style of man no criterion either in using calipers or anything else, as the most essential feature in a mechanic is patience, without which little or nothing can be accomplished. Of course, in Mr. Hetherington's case, it was the boss who threw the calipers, and we will say he had a license to do so, if everybody was fortunate enough to dodge them; but I am sorry it didn't create the proper impression on the apprentice, as I never saw a man worth shop room who couldn't do his work without cursing and throwing things around; and I claim that all the means of adjustment Mr. H. could furnish on a pair of calipers would be of little service to such men. In the same letter, referring to mud drums, he says it is a good thing we don't all think alike; and I agree with him on that point, as the style of calipers he condemns is adhered to by nine-tenths of our best mechanics at the present time, and, with few exceptions, they are home-made.

As to the length of time such a pair of calipers will remain in good condition, I would inform him that I have two pairs of inside and outside calipers which I made twenty years ago (while an apprentice), and he couldn't have them for all the store calipers he could bring in a wheelbarrow, though they have been constantly in use. No mechanic expects to throw his calipers down after trying the size, nor will he thrust them in the hole as though he was pushing a cork grappler in the neck of a bottle, nor is it necessary to have the joint so tight that all the knocking they require while setting destroys them. Mr. Hetherington will find that my letter was on "The Use of Calipers," and not their construction, apart from the points; and his letter refers principally to an omission of what is really a secondary consideration. Most shops are supplied with outside calipers such as he advocates, for large work, but for ordinary shop work they will never be universally adopted, as they never fail to twist in tightening the thumbscrew, and this feature alone will cause a lathe hand to dread them, where accuracy is required. The extension gauge is also to be found in most shops to take the place of inside calipers for large work, and its adoption speaks for its merit.

In conclusion I would say that store calipers are good enough for a man that can't make them for himself, as there is little fear of the work he will get requiring anything better.

JOS. A. ROTHWELL.

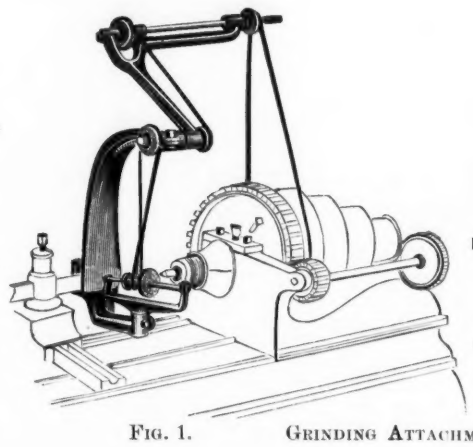


FIG. 1.

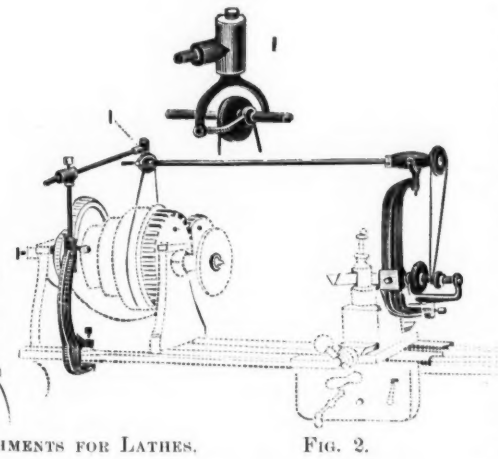


FIG. 2. GRINDING ATTACHMENTS FOR LATHES.

Walker's Adjustable Surface Gauge.

The cuts presented herewith show a new adjustable surface gauge, which possesses some new features, of interest to mechanics who have use for such a tool.

FIG. 1.

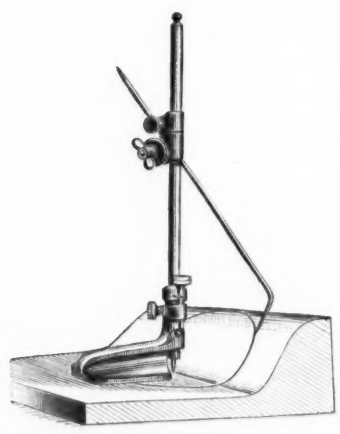


FIG. 2.

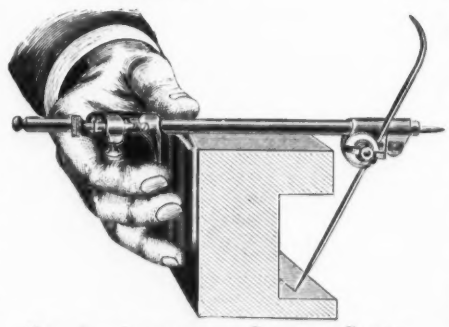


FIG. 3.—ADJUSTABLE SURFACE GAUGE.

Fig. 1 shows the gauge in use as a depth gauge. As will be seen, the base is of a convenient shape for handling, and has an overhanging projection, through which the stem slides freely. In a rectangular opening in this projection is placed a block, through which the stem also passes. This block is split and can be clamped firmly to the stem by a knurled head clamping screw. The block is also tapped out to receive the vertical adjusting screw, which is journaled above, and by means of which the block is adjusted vertically, of course carrying the stem with it when clamped. This provides the adjustment, when it is used either as a depth gauge or as a surface gauge.

The lower end of the stem is provided with a piece of pointed steel wire, which constitutes the point of contact when gauging depths, and is also used in the manner indicated in Fig. 2.

This figure shows the manner of using the gauge for scribing a circle, where ordinary dividers utterly fail to work. In this application of the tool, the center of the hole being located and a center mark made, the point of the stem is placed in the mark and held there. Then, the scriber being set to the desired radius and clamped, the head is left loose on the stem, when, upon being swung round, it rises and falls in a vertical line over the center, thus striking a true circle, regardless of the shape of the surface.

Then, if it is desired to lay off the projection of a circle at an angle with the surface upon which it is struck, it may be done by blocking up under the base so as to make the stem stand at the required angle.

The stem may be inserted into the base from below if desired, and the gauge then used, as shown by Fig. 3, where a line is being drawn in the recess parallel to the base of the piece, without the use of a marking table or surface plate, the adjustment being, of course, available when in this shape as well as when in the other forms.

The needles are clamped independently of each other, and the screw by which they are clamped does not turn when they are moved to different angles. A part of each of these screws is squared, and the washers which are under the wing nuts fit over these squares, and are thus prevented from turning, thereby avoiding the tightening or loosening of the nuts when the needles are moved.

As will be seen from the above, this tool is useful for a variety of purposes, some of which have not been easy of accomplishment heretofore.

It is made by the E. Walker Tool Co., Erie, Pa.

Recent designs of locomotives built in England and illustrated in English mechanical journals, show a decided tendency towards American practice. One recently built for express and passenger service on the London and Southwestern Railway, from the designs of the Locomotive Superintendent of that road, has a four-wheel truck, or bogie in front, with outside cylinder, and has quite an Americanized appearance. There is no headlight to speak of, and no cab worth mentioning, but this latter feature is just perceptibly larger than they made them a few years ago, and perhaps indicates that they will eventually be made sufficiently large to constitute a shelter for the engineer worthy of the name.

Shoemaker's Grinding Attachments for Lathes.

The accompanying cuts represent attachments, by the use of which grinding may be done upon an ordinary lathe.

As will be seen, either of them may be applied to any lathe without trouble, and without the insertion of any screws. The center grinder, Fig. 1, is much the same as was shown by us in our issue of January 8th, 1887, some improvements in construction having been made since that time.

The traverse grinder, Fig. 2, will readily be understood from the cut. The frame which supports the wheel spindle is fastened to any tool held in the tool post, and can, of course, be set at any angle, and moved either by the carriage traverse, or by the cross-slide for facing.

The driving shaft on top is keyseated its entire length, and slides through the small pulley over the cone, the length of the shaft limiting the length of work which can be ground. They are made to grind 24 inches in length, and any angle can be ground at any point on a piece of work of this length. They are furnished with extra heads for doing inside or fluted work, when desired.

They are made by J. W. Dennis, 14 W. Seneca street, Buffalo, N. Y.

It seems impossible to conduct a series of steam engine tests so as to give satisfaction in the results. Some time since we noted what appeared to be some remarkable results from the tests of small engines at a fair in England. Now we find that the accuracy of the methods employed in testing are questioned in such a way as to lead to the belief that the published results had no value.

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NEW YORK, FEBRUARY 11, 1888.

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Specifications for Pumping Machinery.

Specifications for pumping machinery are not infrequently sent out in such shape as to fail to secure the competition in prices which they are intended, in part, to bring about. This was not the case to so great an extent a few years ago as it is now, because there are many more builders of such machinery now than then, and more diversity in the practice of different builders. Builders of pumping machinery have multiplied during the past fifteen years, and each has added inventions, until now, the practice of no two of them agrees on some important particular or other.

It is sometimes asserted that those who are employed to make the specifications upon which the pumping plant for a town or city is furnished, are interested in making them so that no more than one builder is in really fair condition to compete. There is too much reason to believe that there have been instances of this kind, but we think they are not common. It is true that such specifications are far from being uncommon, but it is more charitable to believe, and is probably true, that their wording results from prejudice in favor of the type of some builder, rather than from any pecuniary consideration.

But whether the specifications are made with a restrictive feature willingly or unwillingly, makes little difference; if they contain this feature they are adapted to restrict or destroy competition in the bids, which is manifestly exactly what those who pay for such machinery do not want. Those who pay for it are interested in results, and are not interested in the question of whether a construction patented to and controlled by some particular individual is adhered to or not.

What the city or town about to put in water-works requires, is a plant that will give the maximum results at the minimum cost, and in cost, of course maintenance and attendance is comprehended. And the way to get these is by submitting such specifications as will give room for the widest competition, subject to such restrictions as to duty and lasting qualities as seem proper.

There is opportunity to buy pumping machinery of any guaranteed duty between fifty and one hundred millions, and the city or town about to put in such machinery should elect what class they are willing to pay for, and then ask for tenders accordingly. If the sentiment is in favor of some particular type of engine, then the dealing should be direct with the builder, without the farce of calling for impossible competition.

Watches as Machines.

Watches are carried for many different reasons. Some men, and most women, carry them principally for ornamental purposes, while others buy and carry them as they would buy and maintain any other machine or instrument, simply for the service they will render.

Watches are usually classed among jewelry, and a ladies' watch, with its elegant, fine gold case, studded with diamonds and other precious stones, is undoubtedly properly so classed, especially if the movement is so small (as many Swiss movements are), as to make it incapable of keeping accurate time.

But the watch of a locomotive engineer is carried by him solely because it is necessary for him to know the exact time, and not for any purpose of display.

To him it is simply a machine, or instrument, purchased and carried for a certain definite and utilitarian purpose, and to suit him every part of it should be like his engine, so constructed and so arranged as to best serve that purpose. If an engineer should find that those bearings about his engine which could be easily seen and examined were of decidedly better material and construction than those which could not be so easily seen, he would condemn the engine and lose all faith in its builder.

Locomotives are not built in that way, but we believe the majority of watches are. Instead of the total number of jewels in a watch movement being so disposed as to give the best results in point of service and wear, they are usually so arranged as to make the best appearance, and since they are usually invisible if placed in the lower plate, they are all put into the upper one.

Now, if watch movements are to be considered simply as jewelry, this is all right; but if they are to be considered as machines or instruments, constructed with a view to the performance of a certain function in the best possible manner, then it is all wrong.

If, as often happens, a wheel or pinion is nearest the lower plate, then, of course, much more wear comes upon the bearing in that plate than upon the corresponding one in the upper plate, in which case a jewel in the upper plate only, is a real injury, because the wear being so much more rapid at one end than the other, the wheel rapidly gets out of square, and the inequality is in this case increased by the jewel, while it would be decreased by placing it in the lower plate.

If a maker of any other instrument of precision, or any maker of machinery, should turn out work constructed upon such a principle he would suffer in reputation, and would be regarded as dishonest. By what principle of ethics are the makers of watches exempt?

If jewels are set into watch cases, they are, of course, put there for ornamental purposes only, and should be so arranged as to make the best possible appearance. But if they are put into the movement, they should be so arranged as to secure the best results in wearing qualities, which is the only legitimate object in putting them there at all.

Considerable astonishment is expressed at the fact that the Atlanta was recently ordered to sea, and to sail in something less than a year after the order. But it will strike the man of some little mechanical thought that what is wanted in the shape of a navy is something ready for service about the time the emergency requiring its use is at hand. As usual, however, in naval matters in this country, it appears that the condition of the Atlanta is not such as to make her very formidable, her large guns being practically useless, because there was lack of appropriation to defray the expense of mounting them. The way of the United States Government, in beginning a job, ceasing for lack of appropriations, then beginning again, and so on till the whole becomes obsolete, is fearful as well as wonderful. It would ruin any private firm about twice a year.

Between complaints against the railroad companies for blowing locomotive whistles to the annoyance of the public, and suits brought against them for damages resulting from a failure to blow the whistle at the proper time, some of the companies seem to think they are having rather a hard time of it.

The success of a suit for damages often hinges upon the evidence as to the fact of the whistle having been blown at the proper time, and we suppose it is with a view to supplying this evidence that a device has recently been patented, which automatically records every movement of the whistle lever, and so informs any one who may be interested when and for how long the whistle was blown.

Literary Notes.

The report of the Commissioner of Railroads of the State of Michigan, for the year 1887, is a large volume of about 650 pages. It contains interesting information in regard to progress of railroad construction and operation in that State.

We have received, through the courtesy of R. C. P. Coggeshall, secretary of the New England Water-Works Association, "A Collection of Diagrams representing the General Plan of Twenty-six Different Water-Works." These plans have been contributed by the members of the association, and compiled by a committee. It is a valuable collection, and one from which those interested in water-works cannot fail to get information. Published by *The Engineering and Building Record*, New York.

THE VOSBURG TUNNEL. A Description of its Construction. By Leo Von Rosenberg, 35 Broadway, New York. Price $1.00.

The author of this work was employed by the Lehigh Valley Railroad Company to prepare drawings which should represent the methods employed in the construction of this tunnel. By permission, he has used these drawings, and other valuable information, in making a record of the work done and the means by which it was done. The illustrations are full, and, with the text, make a valuable book of reference.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(59) J. G. B., Philadelphia, Pa., writes: Please tell me what size of tubular boiler will be right for a 16″ x 30″ plain slide valve engine. The fuel is waste from a saw mill. *A.*—You do not state the steam pressure required, nor the speed. But assuming that the mean effective pressure is to be 50 pounds, the engine making 100 revolutions per minute, then we would advise you to use two boilers, each one having 1,200 square feet of heating surface and 70 square feet of grate surface.

(60) J. T. K., Durham, N. C. writes: 1. Will you please tell me how to set the slide valves on a Harris-Corliss engine 18″ x 42″, doing a duty of 40 horse-power. The valves, since they were set by the expert, have been tampered with, and the exhaust valves chatter a great deal. There are marks on the valves which I think I understand, but before I undertake to adjust them I would like to have some instruction. *A.*—See American Machinist, Feb. 27, 1886. 2. Where is the Prentiss vise made? I want the address of the manufacturers. *A.*—Prentiss Vise Co., 23 Dey street, New York. 3. How are such cutters as Brown & Sharpe's twist drill cutters backed off? *A.*—By special machinery.

(61) Subscriber, Philadelphia, Pa., writes: I want to know how much steam a boiler would generate per minute, subject to a heat of from 600 to 900 degrees of Fah. The boiler is not in contact with the fire, but the hot gases from the fire pass under the boiler in contact with it and through the flues. The temperature is constant. The dimensions of the boiler are 3 feet long, 4 feet in diameter, 150 flues 2 inches in diameter. Also what would be the boiler pressure; the boiler is supplied with water constantly. *A.*—You will obtain per minute about 95 cubic feet of steam at a pressure of 20 pounds, providing the feed water as it passes into boiler has a temperature of 180°.

(62) E. H., Newburgh, N. Y., asks: What trade do you recommend for a young man intending to become a locomotive engineer? Would not a year in the pattern shop and three years in the machine shop be advisable? *A.*—We should advise you to serve an apprenticeship in a private locomotive shop. Experience in the pattern shop will also be advantageous. Whether you can learn the trade in three or four years, depends upon your own energy and capability of learning. If time and circumstances will permit, we would strongly advise you to obtain a thorough education in the public schools, go through the highest grade, and then not only learn locomotive building, but learn to be a thorough machinist, and become familiar with all kinds of tools used in a machine shop. It is skilled labor which is scarce, and can always demand the highest pay.

(63) A. M., Percy, Ill., asks: 1. What is the difference between the foaming and priming of a boiler, and what are the causes? *A.*—Foaming is caused by the presence of oil, dirt or other foreign matter in the boiler; priming is caused by having an insufficient steam room in the boiler. When the latter is the case, the boiler, when in use, will prime continually, and is detected by the continuous fluctuation of the water in the water glass gauge; whereas foaming will occur only at intervals, and is also detected by occasional similar fluctuation of water in the glass. 2. Do you charge anything for answering questions? *A.*—We do not, we are always willing to answer any question pertaining to our specialty, neither do we make any inquiries as to whether the questions are sent by subscribers or constant readers. But since we have often more questions on hand than we have time or space to answer in one or more issues, we must ask our friends to have patience, and give us time to answer.

(64) A. D., New Orleans, La., asks: 1. What is the general practice in charging for work on machine repairs? Is it to add a percentage, for profit, to the cost of the job? *A.*—The practice is to charge by the hour for jobbing work, charging up the stock used, but making no percentage charge. 2. Are machine shops in the habit of doing work for cost for each other? *A.*—No. 3. Are engines in Massachusetts generally run "under"? *A.*—No, running under is the exception.

(65) A. H. R., Rock Bottom, Mass., asks: Can I use kerosene oil as fuel under a small (one-horse) boiler for a boat by using a coil of pipe with 1-32 of an inch holes drilled an inch or so apart in the same, oil to be fed from tank, with valve in pipe to regulate supply? Is the device safe? and if not, why not? and what grade of oil will give the best results. *A.*—Do not use such a device; it is decidedly dangerous, because there is nothing to prevent the oil in the pipes from igniting or exploding. We cannot recommend any grade of oil for the purpose.

(66) X., —— writes: Will you please inform me whether there is any fully practicable fire escape hitherto invented, and if so, could you give a description of the device? If there is none, what kind of fire escape has proved the most successful? *A.*—There have been a number of fire escapes invented, each one claiming some advantage over the others, but which is the best is difficult to decide. We cannot call to mind a sufficient number of cases in which fire escapes have had to be used, so as to say which one has proved the most successful. We believe a thoroughly practicable fire escape has yet to be invented.

(67) R. L. D., Atlanta, Ga., writes: Please give me the rule for calculating the horse-power of a cylinder. I want to find out what part of a horse-power is a cylinder 1 3-16 inch by 2⅜ inch. *A.*—In order to find the horse-power of an engine, the steam pressure, and the number of revolutions per minute must be known, besides the diameter of cylinder and stroke of engine. When all the data is known use the following rule: Multiply the area of the piston in square inches by the average steam pressure, and again by the travel of piston in feet per minute; divide the product by 33,000, the quotient will be the horse-power.

(68) J. W. H., Joliet, Ill., asks: 1. Will a kettle 24 inches in diameter and 30 inches high, be large enough to run two engines with cylinders 1½ inch in diameter and 4½ inch stroke, at 125 revolutions per minute, steam pressure 40 pounds? *A.*—If the boiler is properly set, so that about three-quarters of its surface is exposed to the heat, it will do the work. 2. Let me know the name of good books that tell about locomotives, and how they should be run. *A.*—Locomotive Engine Running and Management, by Angus Sinclair; Catechism of the Locomotive, by M. N. Forney; and Modern Locomotive Construction, in the AMERICAN MACHINIST.

(69) Wm. A., Dayton, O., writes: I am overhauling some well drill machinery, having taper pins and boxes of ¼ inch taper to the inch, and No. 8 thread. I can make the pins by using the power cross-feed in conjunction with the feed-screw on lathe, but it is very hard to get a good box, which is 3 inch taper, 1¾ inches x 5 inches long. Can you suggest any way in which they could be cut without a taper attachment on the lathe? *A.*—We know of no way which would be likely to prove very satisfactory aside from the taper attachment, but the job might be done by setting a slide rest to the proper angle and gearing to it, or, possibly by swinging the head stock. 2. What is the horse-power of a slide valve engine 11½ x 22 inches, running at 80 revolutions, and carrying 80 pounds steam? *A.*—About 36 horse-power.

(70) W. H., Baltimore, Md., writes: 1. I have built a small engine, cylinder 1⅛ inch diameter and 3 inch stroke. What amount of power will I obtain from it? *A.*—You may obtain one-third of one horse-power or considerably less, as the power will depend upon the steam pressure, and number of revolutions. 2. Would a kitchen boiler make a suitable one for this engine? If so, state what diameter and height it should be, and the number of tubes it should contain. *A.*—Kitchen boilers are dangerous things to play with when they contain a steam pressure. Our advice is, do not use one for the purpose of running an engine. As to the size of boiler, it is impossible for us to give suitable dimensions, since you do not state the amount of work to be done. On general principles we should say that you will need a boiler with six square feet of heating surface and about a half of a square foot of grate surface. 3. Would a governor be of any use in so small an engine? *A.*—No.

(71) A. L., Johnstown, Pa., asks: 1. Should a stack for a boiler or a heating furnace, or any tall chimney, be larger at the top than at the bottom, and if so, why? *A.*—There does not appear to be very much difference as between a straight stack and one a little larger at the top. Many engineers believe that a chimney is a little more effective for being larger at the top. By this construction the friction is probably decreased a little, but at the same time the gases are cooled a little more, and we are inclined to the belief that the loss will just about balance the gain. 2. Why will a small roll in a train reduce metal faster than one of larger diameter, the circumferential speed being the same? *A.*—We conceive it is because the small roll acts at one time only upon so much of the surface as it can act advantageously upon. If you conceive the roll to be infinitely large, then the surface would be in contact with the entire length of the bar at once, and it would require enormous pressure to reduce it at all. And this condition is approached as the size of roll is increased.

(72) W. N. B., San Buenaventura, Cal., writes: Please answer a perplexing question. I am raising water to an altitude of 300 feet in 1,800. I use a Worthington duplex pump 7½" x 4½" x 10", and a 40 horse-power boiler. My pump and boiler are three feet below the reservoir, and the water flows into the pump. I use a Hancock inspirator to feed the boiler. I connected the inspirator steam pipe with engine steam pipe; the water supply, to pump suction and pump discharge, with valves between, so I can feed from either pipe. When I am pumping, the suction from the pump will not let the inspirator feed from suction, so I have to supply from the discharge, and the pressure in this is so great that it forces cold water over through the inspirator steam pipe into the pump cylinder, and I have to close the steam connection and let the feed go into the boiler cold. How can I feed it in hot? Have I sufficient pressure from my discharge to feed through a heater? *A.*—You do not state the boiler pressure, and therefore we cannot say positively that the pressure of the discharge will be sufficient to force the water through a heater into the boiler; but if you have the ordinary boiler pressure, such as is generally used for purposes similar to yours, we believe that you have sufficient pressure in the discharge pipe of the pump to feed the boiler with the feed-water running through a heater. The connections of the inspirator are badly made, the steam pipe of the inspirator should be connected to the boiler, and the supply to the inspirator should be taken from a tank which is fed from the suction pipe of the pump. By connecting the inspirator in this manner you will not have any trouble; with this arrangement you may also run the feed-water through a heater placed between the boiler and inspirator.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gear Wheels. See Adv., page 16.

Link-Belting.

Send for catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Engine lathes, 17" to 38" swing, Lodge, Davis & Co.

Cabinet turret lathes, Lodge, Davis & Co.

Shapers, 15", 20", 26", 32", Lodge, Davis & Co.

Upright drill presses, Lodge, Davis & Co.

See "ad." pages 15 and 16, Lodge, Davis & Co.

Shafting Straighteners. J. H. Wells, Tampa Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and patternmaking. Anderson Machine Works, Peekskill, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

For Electric Recording Steam Gauge, write Telemeter Co., 44 Barclay st., New York.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

For catalogue of 20 hand lathes, planers, etc., write to John Steptoe & Co., Cincinnati, O.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

For first-class automatic engines write to Williams Engine Co., 447 North street, Baltimore, Md.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N.Y.

Burnham's New Improved Turbine; sold at cost of manufacturing and advertising. Address York, Pa.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Machinery list free; lathes, drill presses, engines, other machinery bargains. C. L. Jackson & Co., Baltimore, Md.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Before buying any tools, supplies or machinery, send to Montgomery & Co., 105 Fulton street, New York, and get their quotations.

Berryman Patent Feed Water Heater and Purifier, and the Economic Boiler Feed Pump. Benj. F. Kelley, 91 Liberty st., New York.

Nicholson & Waterman, Providence, R. I., two 48 in. horizontal boring mills; 5 in. cutting-off machines; 14, 16, and 30 in. engine lathes.

The Dexter Machine Co., Dexter, Maine, are building a fine grade of engine lathes and upright drills which they sell at a reasonable price.

Mechanical drawing, calculations, etc., taught by mail; just what the young mechanic needs most to know. I. D. Boyer, 324 E. 3d street, Dayton, O.

The Brown & Sharpe Mfg. Co. have placed at No. 23 S. Canal st., Chicago, Ill., a sample line of milling machines and other machinery with S. A. Smith.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc.; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

For practical working drawings of machinery call on A. K. Mansfield & Co., 280 Broadway, N. Y. Lifelong mechanics; one formerly R. R. superintendent motive power. Important references.

New book on gears; Tables giving 3,094 diameters, with rules for calculation of movements of shafts, etc.; sent on receipt of P. O. Note; price, 50 cts. Address C. B. Long, M. E., Worcester, Mass.

Hot Water Supply. A practical treatise on the fitting of hot-water apparatus for domestic and general purposes. By F. Dye. 82 pages, with 25 illustrations. 12mo., cloth, $1. Send for catalogue. E. & F. N. Spon, 35 Murray st., N. Y

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October, 23, 1886 issue, and up to and including January 14, 1888 issue, 41 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton street, New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 56 articles have thus far appeared up to and including the January 21, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each AMERICAN MACHINIST PUBLISHING CO., 96 Fulton street, New York.

The 28 in. lathe illustrated in the AMERICAN MACHINIST some weeks ago has proved very satisfactory. They have been quite generally distributed, being now in Maine, Chicago, Texas, Mexico, and other sections. It is the best lathe for the price now produced, being mechanically designed and strongly proportioned. They are all carefully tested before leaving the shop, and their accuracy guaranteed. These lathes and a large assortment of other machine tools can be seen at the warerooms of Fraser & Archer, No. 121 Chambers street, New York.

MANUFACTURES

Brock & Gwinn will build a planing mill at South Anniston, Ala.

A. B. Cummings will build a plow factory at Jonesboro, Tenn.

J. C. Shields, Staunton, Va., is interested in building a grain elevator.

Cross, Adams & Co. contemplate enlarging their foundry and machine shop at Shelbyville, Tenn.

Bryce & O'Kelly have been given a site upon which to build an iron foundry at Little Rock, Ark.

The Birmingham (Ala.) Tool and Implement Works contemplate increasing their capital stock.

The Spears Axle Manufacturing Company, Wheeling, W. Va., has applied for a charter. Capital stock, $200,000.

The management of the Connecticut Western railroad is canvassing the removal of their shops to Canaan, Conn.

The repair shops of the Florida Railroad and Navigation Company, at Fernandina, Fla., will probably be rebuilt.

The Carpenter Organ Company, Brattleboro, Vt., will largely increase its business this year. About one-fourth the product is exported.

A joint stock company has been formed at Noblesville, Ind., for the manufacture of pipe tools and brass fittings, and to do a general machine business.

The Barbour Machine Works are building, at Anniston, Ala., a machine shop 40 x 80 feet, foundry 50 x 100 feet, together with other shops and buildings.

The John Spry Lumber Company's saw mill, at Sault Ste. Marie, Mich., recently burned, will be rebuilt on a larger scale. This was one of the largest mills in that locality.

The Duplex Fuel Burner Company, Cleveland, Ohio, have issued a catalogue. The claim is that the device made by this company is the only one that will successfully burn fuel oil, using either air or steam, or both.

Elmer E. Cline, Alliance, Ohio, has issued his 1888 catalogue of engines and boilers; also engines and fittings for steam yachts and launches, shaping machines and steam engine and boiler supplies. Mr. Cline also does a general machine business.

The Atchison Sash and Door Company, of Muscatine, Iowa, with a capital of $500,000, and the Road Grader and Ditching Manufacturing Company, of Burlington, Iowa, with a capital of $15,000 were incorporated under the State laws recently.

Robert R. Zell, Robert F. Burton, Robert R. Graf, Howard Munnikhuysen, Henry S. Zell, Charles E. Savage and others have incorporated the Graf Refrigerating Company, Baltimore, Md., to manufacture refrigerating machinery for cold storage. The capital stock is $250,000.—*Manufacturers' Record.*

The Rutland Electric Light Company, of Rutland, Vermont, are increasing their capacity, having found the demand for the electric light in that city in excess of their power to fill. They have ordered a Wainwright feed-water heater which will be the second one of this make they have purchased.

New waterworks, or the improvement of existing works, are contemplated at Sidney, Ohio; Brantford, Can.; Marine City, Mich.; Strong City, Kan., Jamaica, N. Y.; Hugo, Kan.; Cambridge, Md.; Watkins, N. Y.; Monson, Mass.; Lebanon, Pa.; Needham, Mass.; Weeping Water, Neb.; Ness City, Kan.; Malden, Mass.; Highland, Cal; Sonoma, Cal.; Jefferson City, Mo.

J. H. Williams & Co., of Brooklyn, have lately patented an important improvement upon the Brock chain wrenches, heretofore manufactured by them, and illustrated in our issue of June 7, 1884, which consists of a drop forged steel holding-link for attaching the chain to the reversible jaws, in addition to the tempered steel pin now used. By this means greater strength is obtained, and a practical guarantee is given against any breakage in this important part of the tool.

Articles of incorporation of the Newport, Ky., Iron and Steel Works were recently filed. The incorporators are H. A. Schriver, Adam Wagner, Al Gahr, James Matthews and R. W. Nelson. The capital stock is $500,000, divided into $100 shares. This is the stock company that will run the old Swift mill in the future. A majority of the stock is held by Henry Schriver, and Al Gahr will be retained as secretary.

A Pittsburgh special to the *Tribune* says Grapeville, Pa., on the Pennsylvania Railroad, is to have an acquisition in the shape of a rolling mill and iron mill, work on which will begin in the spring. It is understood that the capitalists in the enterprise are Philadelphians and Pittsburghers, of the same company which is now erecting glass works in the same neighborhood in the heart of the natural gas regions. The works will manufacture principally farming implements, and both mills will employ, when running full, between 700 and 1,000 men.

J. Wyke & Co., manufacturers of fine and improved machinists' tools, East Boston, Mass., write us: Our business is good, the sale of our tools having gradually increased during the year just closed (1887). We have almost doubled the sales of our universal screw-cutting, center, depth, angle and twist drill gauges; also our improved end graduated machinist scales. These scales are standard gauges, by which calipers and other tools can be set accurately, independently of the graduation. We have every reason to believe that we shall go on increasing our sales during the coming year, 1888.

Detrick & Harvey, Philadelphia, Pa., write us: The past year with us has been a good one. Outside of a considerable amount of special work, we have been busy on our open side planers, owing doubtless to their creditable performance in practice, which is rapidly removing the natural prejudice against the innovation. We anticipate a good trade in them for the present year. To our plant we have added a number of modern tools, which, together with a good proportion of skilled New England labor, have produced undoubtedly good results in our product.

The Springfield Glue and Emery Wheel Company, Springfield, Mass., write us: Our business in 1887 exceeded that of 1886 in total shipments about 25 per cent. We enlarged our plant the past season by putting in new machinery and improved ovens in our emery wheel department, giving us four times our former capacity. In the machine shop have put in new lathes, planers and drill presses, increasing our capacity one-third. We have not been caught up with our orders during the year, and the new year is opening up with good sized orders daily, and we look forward to a prosperous season. The prices of labor and material remain about the same as a year ago.

A Des Moines, Iowa, correspondent writes us of two machinery firms of that city: "N. S. McDonnell & Co. manufacture engines and boilers, iron bridges, tanks, coal running machinery, hoisting engines, and do general repairing. They have greatly enlarged their works during the past season, and added many machine tools of the best quality. Orders are still increasing, and early in the spring they will build a large foundry and will add more machine tools. They have recently taken orders to repair and rebuild several narrow gauge locomotives for the Oceola R. R., also bridge work for the city. Geo. L. Jarrett, builder of all kinds of grist mill machinery and steam engines, has largely increased his facilities, and has large orders ahead. As soon as the weather will permit he will build a new foundry, put in more machine tools and employ more men."

The Kensington Engine Works, L'd., Francis Bros., Philadelphia, by reason of the great increase in the number of their clients, have been forced to establish a special engineering department, under direction of Mr. H. C. Francis, which will have in charge all matters relating to steam power, transmission of power, etc. This department is conducted independently of the works, and is prepared to execute work as engineers and contractors, under approved plans, for whatever is required. At the present time, John Lang, paper manufacturer, Philadelphia; S. Sternberger, shirt manufacturer, Bank and Market streets, Philadelphia; Samuel K. Wilson, electric lights, Trenton, N. J.; Baxter Electric Manufacturing and Motor Company, Baltimore, Md., have new work and alterations in their charge as engineers.

Machinists' Supplies and Iron.

NEW YORK, Jan. 26, 1888.

Iron—American Pig—Trade is generally quiet, contracts being delayed until the difficulty with the coal miners is adjusted. There are no large stocks, and apparently no inclination to accumulate. We quote Standard Lehigh brands $21 to $21.50, for No. 1 X Foundry, with outside brands at $20 to $20.50. No. 2 Foundry $19 to $19.50 Standard Lehigh brands, others at $18 to $18.50; Grey Forge from $16 to $17.

Scotch Pig—We quote Coltness, $22 to 22.25; Glengarnock, $21 to $21.50; Gartsherrie, $21.50 to $22; Summerlee, $21.75 to $22; Eglinton, $20 to $20.50; Langloan, $20 to $20.50; Dalmellington, $20 to $20.50, and Clyde, $20 to $20.50.

Lead—The market has ruled firm. Spot is held at 5c. with 4.90c. bid, and at the exchange 150 tons have changed hands at 4.95c. for February, and 4.97½c. for March, and 4.95c. for May.

Antimony—Regulus has been in moderate jobbing demand at slightly easier prices. We quote Hallett's brand 11c. and Cookson's 14c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to sell planes, see page 11.

Wanted—Draftsman with some experience on printing machinery. W. S., AM. MACHINIST.

A mech'l draftsman and designer has had practical shop exp., wants position. Box 81, AM. MACHINIST.

Wanted—Two first-class men to turn shafting; state experience and wages wanted. Shafting, AM. MACHINIST.

Experienced machinist in building marine and stationary engines; capable of handling men, wants position. B. J., AM. MACHINIST.

Machine shop foreman; experienced on station. ary and marine engines and machinery, wants engagement. Address F. M., AM. MACHINIST.

Wanted—Situation as superintendent or assistant of machine works; building engines preferred; designer and draftsman; understands indicator. H., AM. MACHINIST.

A mechanical engineer of 20 years' experience of foundry and millwright engineering shop, wishes to go in company with some firm or take charge of some works. B., AM. MACHINIST.

Trained experienced mechanic; designer of machinery and tools; gunsmith, and successful experimenter, wants position in any capacity; highest references. Energy, AM. MACHINIST.

Wanted—A good machinist with push and executive ability; capable of handling about 30 men in general machine shop; no hurry; give age, experience and references. D., AM. MACHINIST.

First-class machinist open for position as foreman or superintendent; large experience in the business; can show the best of references for handling men and cheapening work; good inspector. Box 80, AM. MACHINIST.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head a 35 cents per line, each insertion.

Crescent Boiler Tube Expander; second to none, price in reach of all. Crescent Mfg. Co., Cleveland, O.

The Crescent Link Belt Coupling; something new; sample free. Crescent Mfg. Co., Cleveland, O.

Wanted—Special machinery to build; correspondence invited. Address Drawer F, Shenandoah, Pa.

Wanted—Parties having machinery specialties to build, to correspond with. Box 75, AM. MACHINIST.

Estimates on light machinery and specialties-first-class facilities on machine shop and foundry Address the Novelty Iron Works, Passaic, N. J.

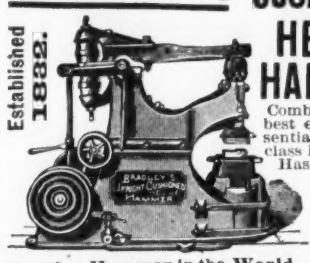
For Sale—54" x 54" x 17' iron planer; 2 heads on crossrail, used a short time; to make room for a 60" planer. John Steptoe & Co., Cincinnati, Ohio

Steam users who desire to keep their boilers clear of scale at a cost of 10 cents a week, should read the card of the Pittsburgh Boiler Scale Resolvent Company on page 12. It will pay them.

A. C. Christensen, 26 Church st., N. Y., mech. and hydraulic engineer. Prepares designs of water-works pumping stations, drawings of steam pumps, pumping engines, gen. mach'ry and pat. drawings.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1832.



Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the World.

Bradley's HEATING FORGES

Established 1832

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements.

For hard coal or coke. Indispensable in all shops to keep **Bradley's Cushioned Hammers** and men fully employed and reduces cost of production.

BRADLEY & CO., Syracuse, N. Y.

STEPHENS PATENT VISES

ONE-HALF TIME and LABOR saved by using this solid, strong, durable, firm-hold, quick-working Lever (Not Screw) Vise. Has improved Taper-Pipe and other attachments. Sold by the trade. Send for circular.

TOWER & LYON, 95 Chambers Street, New York. Successors to MELVIN STEPHENS.

STEAM PUMPS for Hot or Cold, Fresh or Salt Water; for Oils, Naphtha, Tar; for Cane Juice, Liquors, Syrups, Scum; for Ammonia, Alkalies, Extracts, Acids; for Thick, Volatile, Viscous or Foul Liquids, etc. **VACUUM PUMPS** of the highest efficiency. **FILTER PRESS PUMPS.** Air, Gas and Acid Blowers. **AIR COMPRESSORS,** Etc. **BUILT BY**

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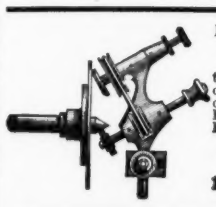

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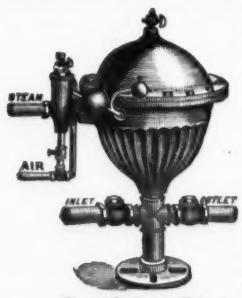

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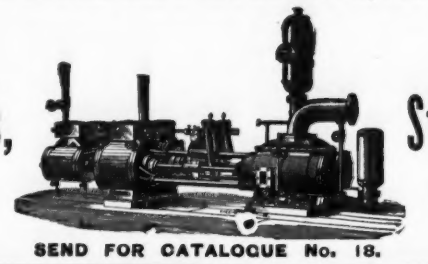

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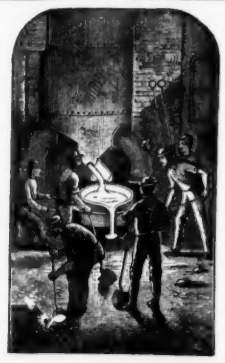

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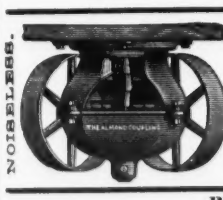

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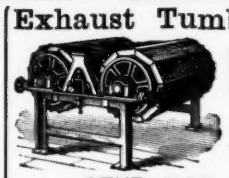

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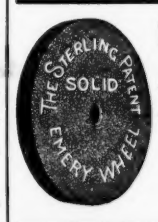

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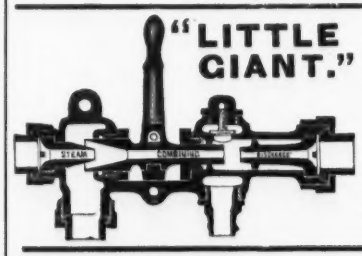

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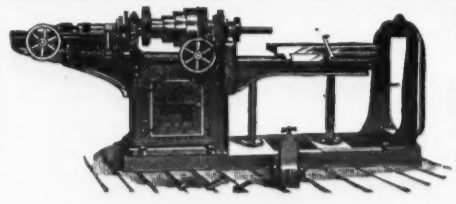

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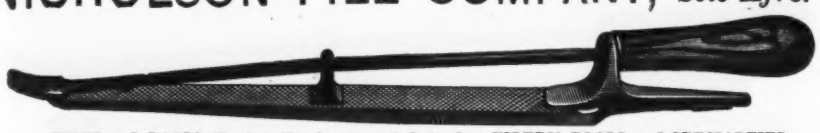

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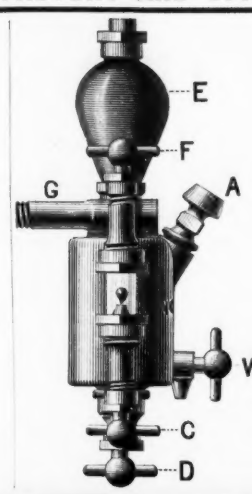

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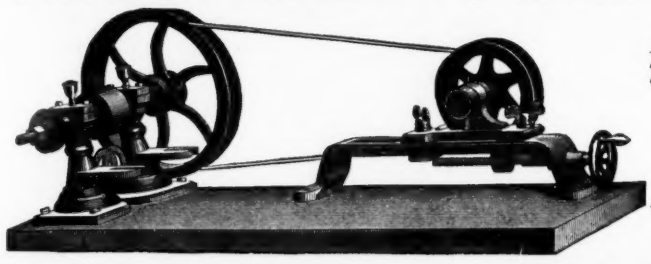

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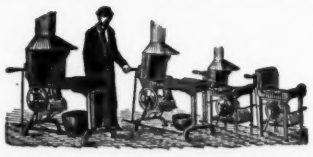

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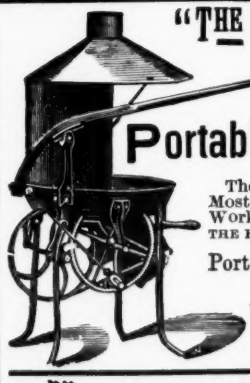

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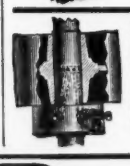

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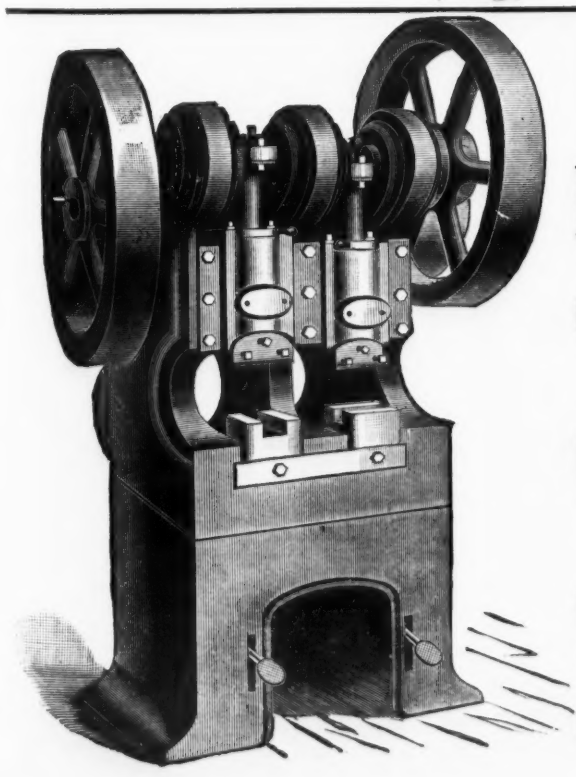

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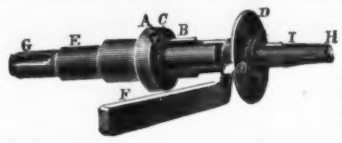

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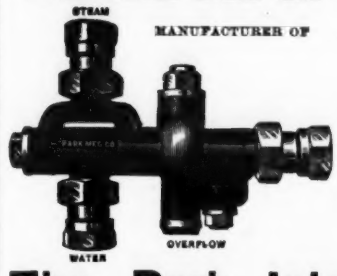

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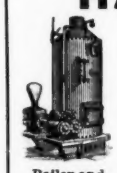

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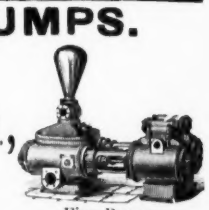

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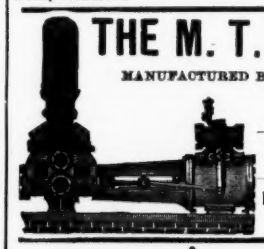

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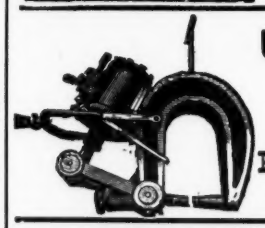

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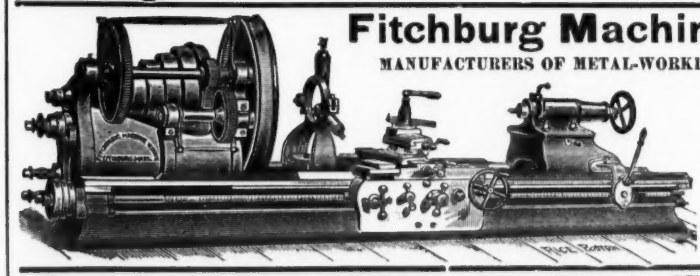

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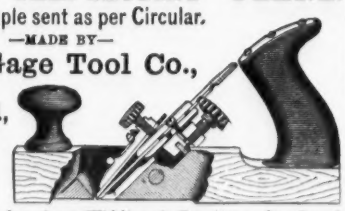

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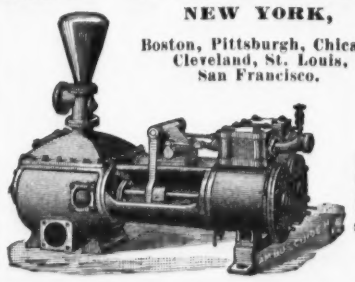

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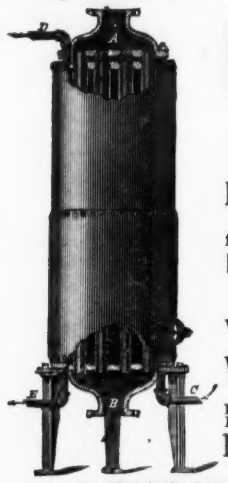

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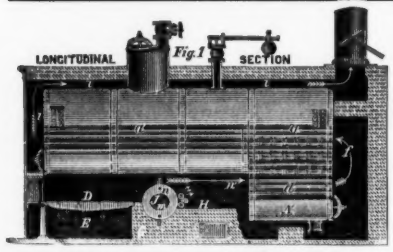

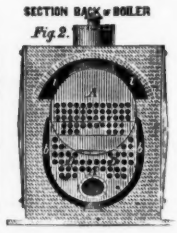

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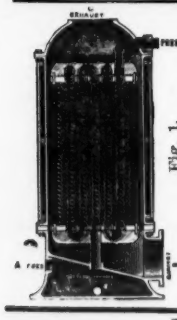

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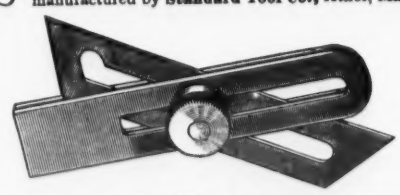

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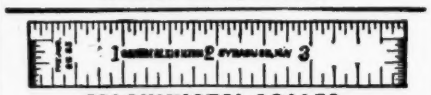

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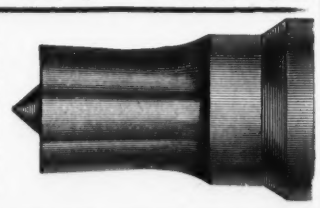

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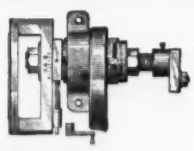

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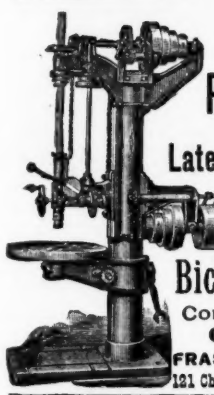

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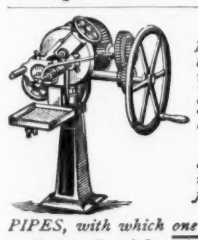

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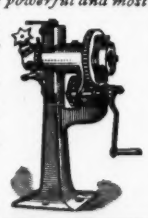

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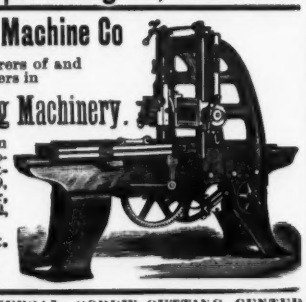

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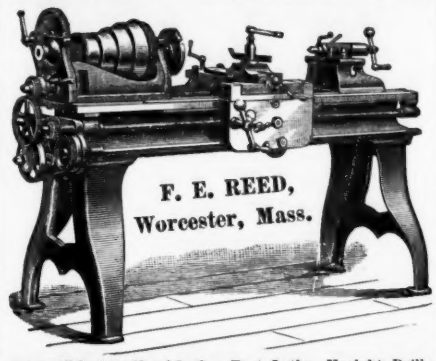

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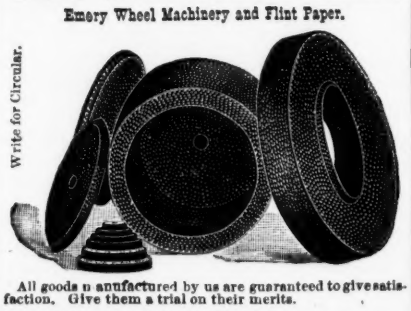

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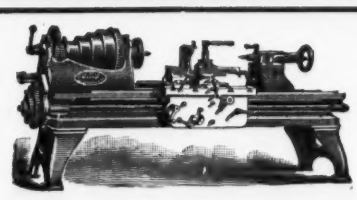

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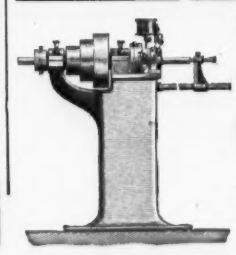

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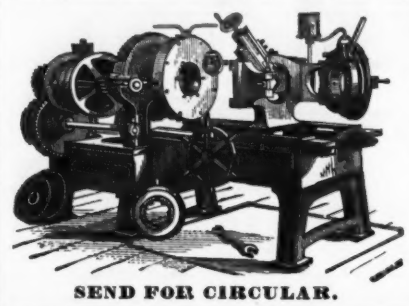

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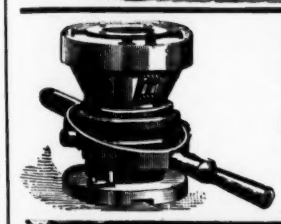

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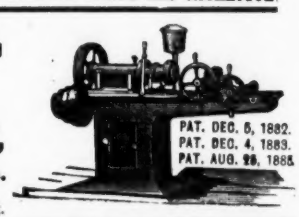

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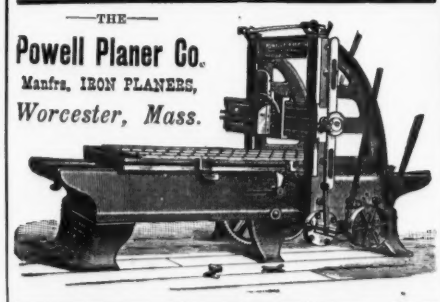

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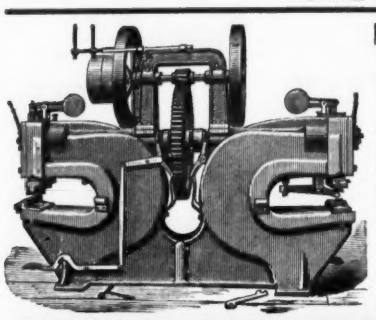

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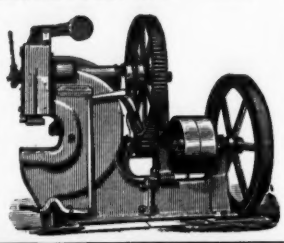

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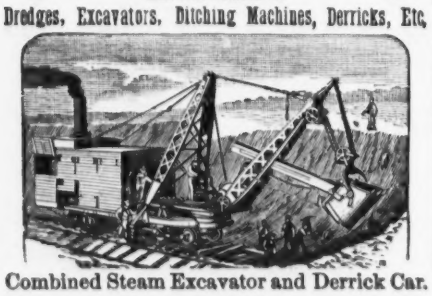

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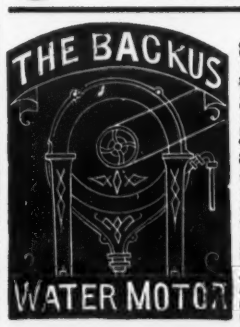

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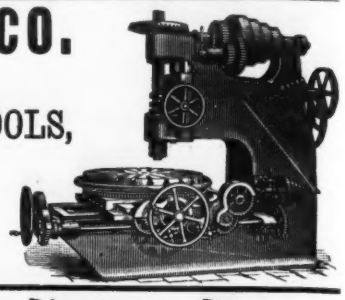

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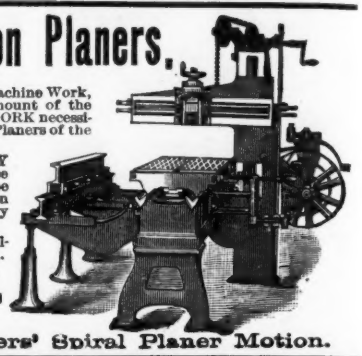

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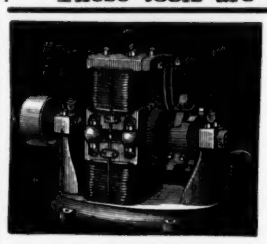

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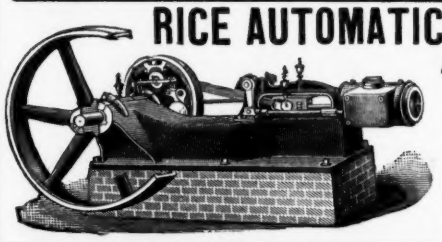

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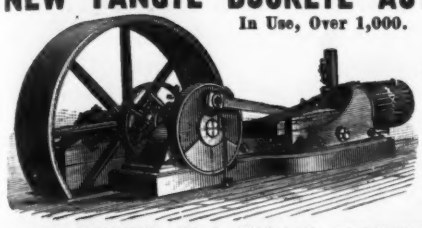

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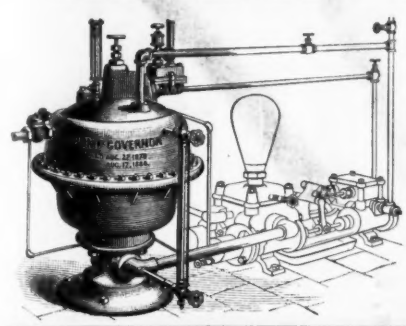

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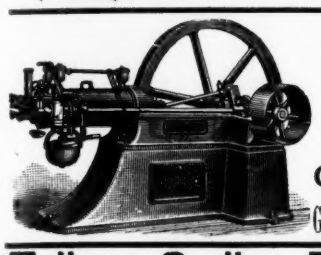

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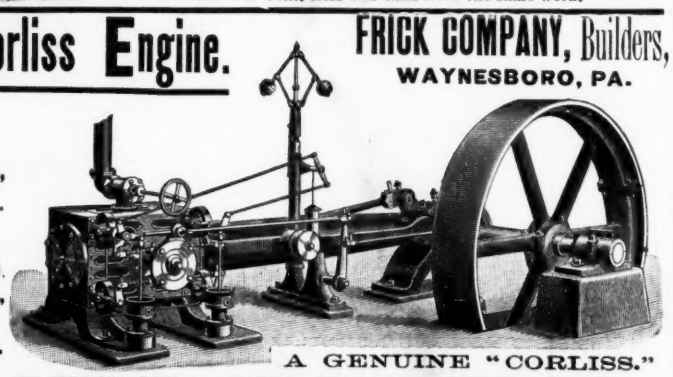

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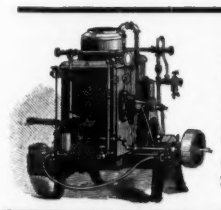

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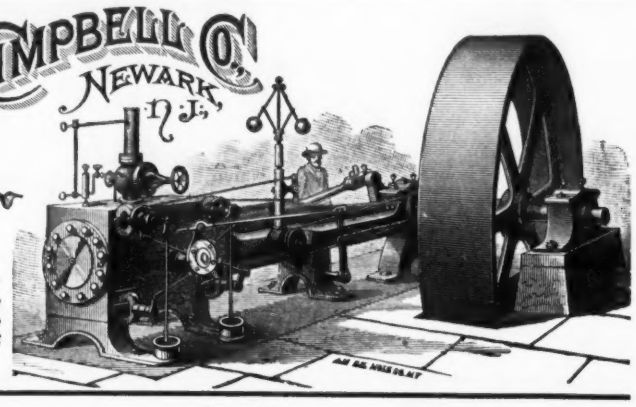

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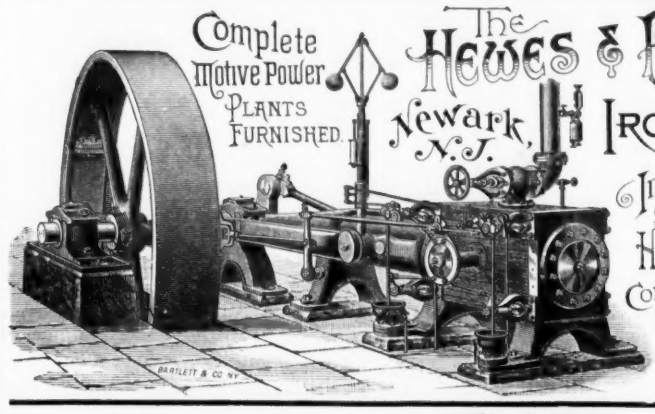

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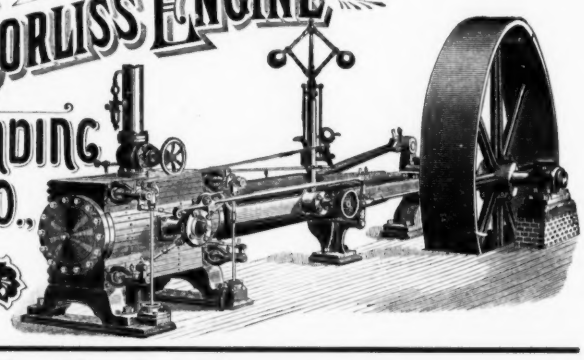

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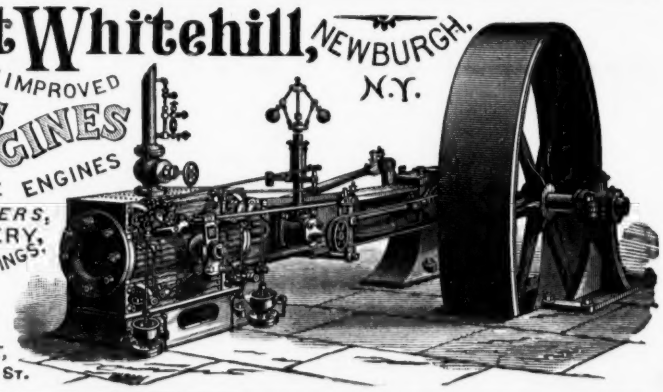

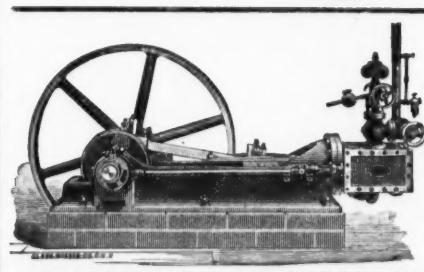

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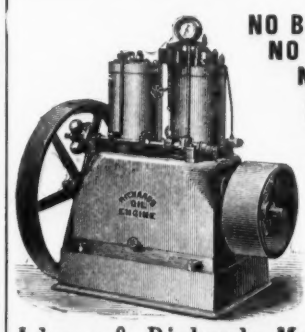

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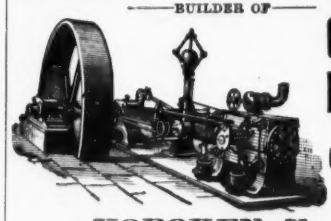

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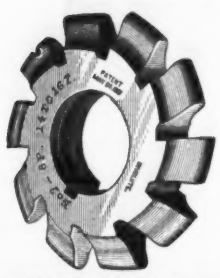

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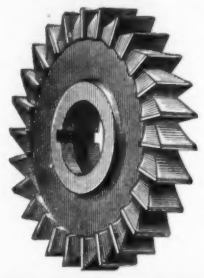

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FORMED CUTTER.

Coincident with the rapid and wide extension of the use of Milling Machines, has come an increased demand for Milling Cutters. Without good cutters, the efficiency of Milling Machines is much abridged.

In extending the product of its Milling Department, the BROWN & SHARPE M'F'G CO. has made many new varieties of Milling Cutters, and in order to supply the wants of customers, has found it necessary to greatly increase the number carried in stock. The INVOLUTE GEAR CUTTERS in stock are from 3 to 48 pitch, 8 cutters to each pitch. The Epicycloidal are from 2 to 10 pitch, 24 to each pitch. The curves of gear cutters are obtained by machinery. SIDE MILLING CUTTERS, from 3 1-2 in. to 8 in. diameter, are carried in stock. On work having parallel surfaces, these cutters may be used in pairs FORMED CUTTERS, for cutting various outlines, are made to order. These, as also the Gear Cutters, can be sharpened without changing their original form—a feature appreciated by those producing work in duplicate. By making cutters in large numbers, with expensive special tools, much greater accuracy has been attained than can be reached by the usual methods of manufacture. Users of cutters will generally find it more economical and satisfactory to purchase from experienced makers, rather than to attempt to manufacture for themselves. Catalogues mailed on application. All kinds of cutters made to order.

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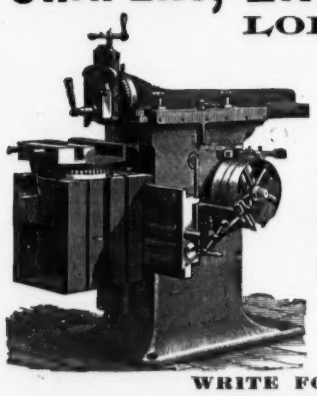

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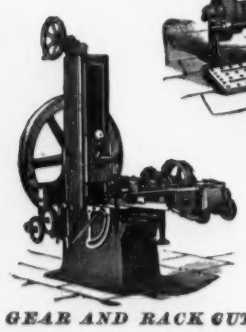

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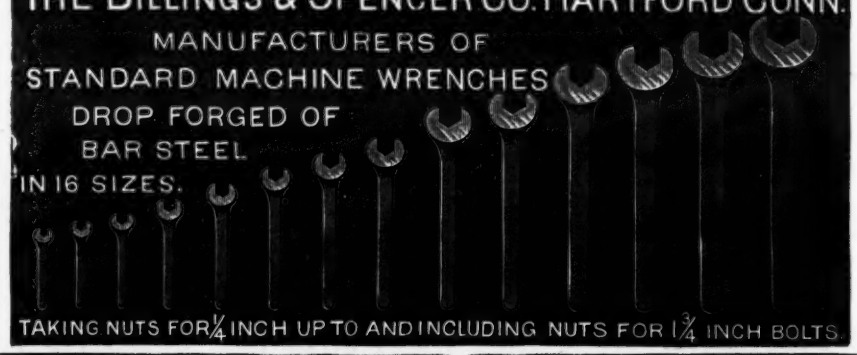

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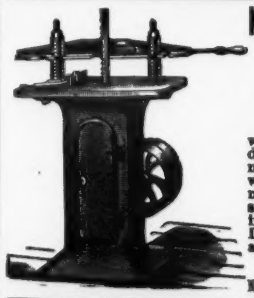

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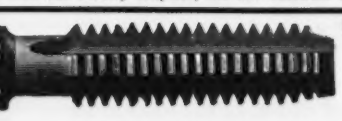

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